SCIENCE

FRIDAY, MAY 22, 1896.

CONTENTS:

MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A SUCCESSFUL TRIAL OF THE AERODROME.

THE editor of SCIENCE has received the following letters containing an announcement of great scientific and practical importance:

THE EDITOR OF SCIENCE—*Dear Sir:* After having published some investigations in aerodynamics ('Experiments in Aerodynamics' and 'The Internal Work of the Wind'), I have made further experiments on the practical application of these conclusions, in the construction of an actual aerodrome or flying machine, upon a scale sufficient to admit of the employment of a steam engine of between one and two-horse power. I have never given any account of these experiments, as I have wished first to attain such a complete control of the flight as would insure its being automatically directed in a horizontal course, in any desired azimuth; but in view of the demands upon my time, which render it uncertain how far I can continue my personal attention to the completion of this object, I have yielded to the request of my

valued friend, Mr. Graham Bell, to authorize the publication of a general statement of the results thus far obtained.

Let me add, in explanation, that the scale of the construction did not admit of any apparatus for condensing the steam or economizing the water, which, therefore, could only be carried in sufficient quantity for a very short flight. This difficulty is peculiar to the scale on which the experiment is conducted, and does not present itself in a larger construction.

Professor Bell has shown me his letter, which follows.

Very respectfully yours,

S. P. Langley.

Washington, D. C., May 12, 1896.

The Editor of Science—*Dear Sir:* Last Wednesday, May 6th, I witnessed a very remarkable experiment with Prof. Langley's aerodrome on the Potomac River; indeed, it seemed to me that the experiment was of such historical importance that it should be made public.

I am not at liberty to give an account of all the details, but the main facts I have Professor Langley's consent for giving you, and they are as follows:

The aerodrome or 'flying machine' in question, was of steel, driven by a steam engine. It resembled an enormous bird, soaring in the air with extreme regularity in large curves, sweeping steadily upward in a spiral path, the spirals with a diameter of perhaps 100 yards, until it reached a height of about 100 feet in the air at the end of a course of about half a mile, when the steam gave out, the propellors which had moved it stopped, and then, to my further surprise, the whole, instead of tumbling down, settled as slowly and gracefully as it is possible for any bird to do, touched the water without any damage, and was immediately picked out and ready to be tried again.

A second trial was like the first, except that the machine went in a different direction, moving in one continuous gentle ascent as it swung around in circles, like a great soaring bird. At one time it seemed to be in danger as its course carried it over a neighboring wooded promontory, but apprehension was immediately allayed as it passed 25 or 30 feet above the tops of the highest trees there, and ascending still further its steam finally gave out again, and it settled into the waters of the river, not quite a quarter of a mile from the point at which it arose.

No one could have witnessed these experiments without being convinced that the practicability of mechanical flight had been demonstrated.

Yours very truly,

Alexander Graham Bell.

1331 Connecticut Avenue,
Washington, D. C., May 12, 1896.

THE DEVELOPMENT OF EXOGENOUS STRUCTURE IN THE PALEOZOIC LYCOPODS—A SUMMARY OF THE RESEARCHES OF WILLIAMSON AND RENAULT.

The fact of the occurrence of exogenous structure in the Lycopodineæ, Equisetineæ and some of the ferns of the Carboniferous age is in itself hardly less remarkable and interesting than is the variety of phases under which this structure makes its appearance. It would seem that during the rapid differentiation and modification of vascular plants at the time of the great coal formation, plants of these lower classes played fast and loose with exogeny, shaping in fantastic and capricious designs a structure that is now the garb of the most exalted classes. Even within the boundaries of the *Lepidodendra* and the *Sigillariæ* the diversity is so great that while some species show no secondary growth at all, others, especially among the *Sigillariæ*, are so highly organized that the followers of the Brongniartian

school still range them by the side of the Gymnosperms.

As representing the latest stage in the progress of knowledge concerning exogenous development in the Paleozoic Lycopods, as well as expressing the views of the foremost authorities in Paleozoic plant histology in both the Brongniartian and the English schools, I venture to summarize, in brief, without pretense of adding anything original to the subject myself, the contents of two lately published papers.

The first, by the late Prof. W. C. Williamson, of Owens College, England, his last independent publication, I believe, is entitled, *On the light thrown upon the question of the Growth and Development of the Carboniferous Arborescent Lepidodendra by a study of the details of their Organization.**

At the outset it may be well, and of interest to the reader, to briefly review the general structural characters of the Lepidodendron type, in describing which I shall quote in part from Prof. Williamson's own publications: "In the youngest Lepidodendroid twigs the conspicuous central tissue is a small vascular bundle known as the primary xylem strand. It extends, under varied modifications of form and size, from near the apex of the youngest twig to the base of the oldest stem. In its downward course it gives off a large number of small vascular bundles, known as leaf traces, each one of which passes outwards to a leaf, supplying it with its vascular tissues. In many cases we discover a few cells in the center of its component tracheids, which, on passing downward towards the lower members of the tree, enlarge into a more or less conspicuous medulla. In a few cases the smaller shoots exhibit no traces of these cells, which are only discoverable in branches of somewhat larger size; but in all, the larger the twig, the larger, also, is the central cellular tissue in varying degrees and in different types. This is a true medulla, which generally exhibits its maximum diameter only at the base of the oldest stems."

In the closest external contact to this primary xylem system is a second vascular zone, the 'secondary xylem,' which is developed from a peripheral cambium layer much like the growth of ordinary trees. This secondary xylem is composed of vertically prolonged radiating vascular laminæ, which are separated by intervening medullary rays. These two systems form the 'stele,' and the Carboniferous Lycopods are 'monostelic.' The remaining external zones of tissue constitute the leaf-bearing cortex. "In its youngest state this tissue consists almost wholly either of rounded cells, parenchyma, or vertically elongated ones with pointed ends, prosenchyma." At a later period of growth, varying in different types, a thin meristemic zone appears in the outermost parenchyma of the cortex. A ring of its rounded cells, as seen in transverse section, undergoes divisions, the more internal developing into prosenchymatous ones to form a layer of periderm. This periderm constantly thickens by similarly produced exterior additions so long as the plant lives, constituting the great bulk of the tree trunks, which may attain a diameter of four feet or more. The outermost cells resulting from the above-described meristemic action experience a succession of similar metamorphoses, always preserving a thin layer of parenchyma between the surface of the periderm and the bases of the leaves. The leaves, which are variable in form and size, are attached by rhomboidal bases to the bolsters or leaf cushions, which, though square and hardly larger than the leaf base when young, continue to grow after the true leaf falls off, and their diamond-shaped, often fusiform protuberant bolsters, arranged in quincunx, form the

*Mem. Proc. Manchester Lit. and Phil. Soc., 1894-95, pp. 31-65, 1895.

usual netted impressions characteristic and familiar in the fossil remains. The leaf scar bears three well-marked points. The Lepidodendra always branch dichotomously.

Concerning the mode of development of the primary xylem or central part of the stele there has been lack of evidence and consequent radical difference of opinion. To the solution of this problem Prof. Williamson devoted the six summer months of 1894 examining the slides in his extraordinary collection numbering several thousand specimens, and counting or calculating with great precision the number of cells in the primary and secondary xylem systems.

The study of the dichotomies of the branches has thrown great light upon this important question, for "It is to the ascending series of these dichotomies that the Lepidodendra owe their characteristic structure and modes of development."

The first change in the normally cylindrical ordinary branch is the splitting of the central vascular cylinder of primary xylem and its contained cellular medulla. The cylinder splits vertically for a short distance into two crescentic, diverging halves, while the external form of the branch becomes oval, the difference between the longer and shorter axes being greater as we ascend to the dichotomy. Before reaching this the two horns of each crescent of primary xylem approach each other. At this stage the cells of the two medullæ are in direct contact with those of the inner cortex. Several of Prof. Williamson's sections show that the crescentic condition is permanent for a short space at least, approximating what DuBary calls the 'foliar gap' in ferns. Higher in the dichotomy, however, the horns of each crescent rapidly converge to form two new cylinders, 'differing in no respects, save size and number of internal parts, from that of the parent stem.' The same phenomena occur with each successive dichotomy, each pair of resulting branches, though diminished in diameter, having exactly the same type of organization as the one from which they sprang. Thus, however numerous the dichotomies they are all produced alike and no structural changes are introduced 'from the base of the parent branch up to the smallest twig of the full-grown tree,' save certain secondary ones produced by growth processes which begin to manifest themselves at the base of that trunk. It will at once be seen that the number of cells and vessels of the cortex, primary xylem and medulla is one-half as great in each of the two branches as in the parent below the bifurcation. A similar ratio obtains in the number of leaves. Such dichotomies occur only when the twigs are terminal with a growing point.

Besides these equal dichotomies there are two sorts of unequal dichotomies different in structure and purpose. In the first only a small segment is cut out of the primary xylem cylinder and passes outward, carrying with it a small portion of the medulla to form a branch. This unsymmetrical segment becomes a solid strand with or without any trace of a medulla, though usually on reaching the axis of the cone, which it usually supports, a central medulla is shown. In the second form of unequal dichotomy the medulla is unaffected, a limited number of tracheids being detached from the periphery of the primary xylem cylinder. These strands may also go to reproductive organs.

In answer to the hitherto open problem as to how far the ordinary growth of a branch has exerted any influence upon or borne any relation to the varying dimensions of the primary xylem cylinder of the stele and upon the number of its component tracheids, the author's examination

leads to this conclusion: "Unlike what occurs amongst the living Lycopods, amongst the Carboniferous Lepidodendra we find as we descend from the uppermost and youngest shoots, that there is a regular progressive enlargement of the branches below each succeeding dichotomy; * * * and these enlargements are accompanied by a similar though less conspicuous enlargement of the cylinder of the primary xylem, and also in the number of its component tracheids."

Prof. Williamson's examinations relate in particular to seven species of Lepidodendron.* Of these *L. Selaginoides* differs from other studied Lepidodendra in having the tracheids of the primary xylem, which are crowded at the outer periphery, more open and fewer in approaching the center of the system, where they often mingle with a peculiar barred parenchyma that occupies the place of the medullary cells in other species. In one specimen of this species the primary xylem has reached a diameter of nearly 3 mm., the cortical diameter being nearly 17 mm. before a small crescent of secondary xylem is discerned. At a more advanced stage the diameter of the primary xylem cylinder is 6 mm., the secondary xylem 14.5 mm., while the cortical is 92 mm.

Of *L. brevifolium*, which is remarkable for its frequent dichotomies, of both the equal and unequal types, Prof. Williamson obtained a section, below a dichotomy, in which a secondary xylem of a maximum thickness of 5 mm., invested the two tracheal crescents of primary xylem, the secondary xylem tissue being seen to grow around the horns of each of the primary xylem crescents and to push its way into the interior of their contained medullæ.

Exceptionally favorable conditions of preservation have made it possible to trace the development of the tissue in *L. Wunschianum* from the youngest twigs down to stems six feet in circumference. In this plant specimens in which the primary xylem is 4 mm. in diameter show no medulla, though on reaching a diameter of 5.5 mm. a medulla nearly 2.5 mm. in diameter appears. But the remarkable fact that the smallest stem in which a trace of secondary xylem was found showed the diameter of the cortex, primary xylem and of the medulla to be 23 cm., 36.5 mm. and 24 mm., respectively, while the very thin ring of secondary xylem is but 4 mm. thick on one side and 1 mm. thick on the other, demonstrates that the branches of this species attained a relatively large size before the growth of secondary xylem began.

In *L. Harcourtii*, the study of a section of which led Brongniart astray and began the conflict between the English and the French paleobotanists, the author elucidates several minor disputed points. It is noteworthy that no exogenous or secondary growth has yet been found by any of the investigators of this species, for the possible reason, as Williamson suggests, that the secondary xylem does not appear until a stage more advanced than that represented in any specimens yet examined.

Two of the sections of *L. fuliginosum* give the following diameters: 1st—cortex, 19 mm.; primary xylem, 3.5 mm.; medulla, 2 mm. 2d—cortex, 60 mm.; primary xylem, 7 mm.; medulla, 6 mm. At an advanced stage of growth, among the radial lines or cells of the innermost cortex, are found parallel lines of true tracheids, 'rudimentary representatives of the secondary xylem zone.' These cells pursue an irregular course longitudinally, and are unequally distributed in the cortical ring in which they occur.

* We can refer to but a few of the author's observations. Those who wish further data will find such tabulated in the present paper and illustrated in the magnificent series of memoirs 'On the Organization of the Fossil Plants of the Coal Measures,' published by Prof. Williamson during the last twenty-five years in the Transactions of the Royal Society of London.

The examination of numerous sections, including one only, 1 mm. in cortical diameter, of *L. mundum*, a low species, shows the same habit of development, and, in the descending from the smallest twigs to larger and lower branches, the same enlargement of the primary stele as a whole and of the number of its component tracheids as in the other arborescent forms.

The painstaking and exhaustive study of his remarkable series of sections led Prof. Williamson to abandon his earlier views, while approaching in the main to those set forth by Solms-Laubach in his Fossil Botany. The impossibility of intercalating leaves and leaf traces among the prearranged geometrically disposed spirals and the observed numerical progression of the volume of tracheids in passing downward lead to the inevitable conclusion that, unlike any living type of growth, these enormous developments of primary tissue originate at the base of the primary stem close to a growing point.

Here the chain of corroborative observation ends and the difficulties and further unsettled problems begin. Prof. Williamson adds: "As to the magnitude of the primary xylem strand and the enormous number of tracheids which compose it, these equally reached their largest proportion at the base of each solitary aërial stem. How such numbers of tracheids, varying in the type of *L. Wunschianum* from 4,000 to 15,000, could be produced in that position is difficult to understand. The *young* sporophyte could not possibly have contained them; hence some process of growth, of the nature of which we have as yet no knowledge, but which was capable of producing these marvelous results, must have succeeded, if not been developed out of the sporophyte."

The second paper, entitled *Sur l' utilité de l'étude des plantes fossiles au point de vue de l'évolution des organes*, is by M. B. Renault,* the leader of the French paleobotanical histologists.

M. Renault draws a very suggestive contrast between the present general grouping of living plants and what would be expected if the manifest relations of the fossil species were taken into consideration; for vegetable paleontology shows the existence of vast numbers of individuals presenting in different degrees characters intermediate to those which obtain among the living plants. If the fossils are included in the same classification with the living plants it will be difficult in many cases to establish perceptible demarcations between, and preserve intact the living groups.

As to the appearance of secondary growth and its use as a basis of classification, the author points out that such growth is seen first in the rhizomes, then in the stems, branches, leaves and fructifications respectively. Thus the subterranean stems of the living *Helminthostachys* and *Botrychium* show the secondary xylem while the aërial portions have the structure of the Cryptograms.

Lepidodendron Harcourtii (mentioned in Williamson's paper), *L. rhodumnense* and *L. esnotense* are cited as simple arborescent Lycopods, the trunks of which are without trace of secondary growth. *L. vasculare* and *L. selaginoides* show a secondary xylem cylinder of varying thickness in the stems. The *Stigmariæ* he considers more highly organized than the *Sigillariæ* which, according to the Brongniartian School, they bore. *Diploxylon*, regarded by some as a Lepidodendroid stage, by others as a *Sigillaria*, has a thick primary xylem surrounded by a bed of secondary xylem, the latter growth being found in not only the roots and stems, but in the foliar bundles also, as far as the base of the leaf.

The smooth Sigillarias, differing from *Di-*

* Bull. Soc. d'Hist. Nat. d'Autun, VI., 1893, Pp. 499–504.

ploxylon, especially by the marked diminution in the diameter of the primary xylem, exhibit the secondary growth in roots, stems and leaf bases, but only as an elementary stage in the leaf itself.

Representing the present Brongniartian School, M. Renault cites the somewhat anomalous *Poroxylon* group ('although belonging rather to another series leading to the Conifera') as examples showing the double growth in roots, stems and leaves, predicting that their still unknown fruits will probably be found to be small seeds constructed on the plan already observed in the contemporaneous *Gymnosperms*. If so, the *Poroxylon* will be especially exemplary in combining the characters of *Phanerogams* and *Cryptogams*. The 'libero-ligneous' bundle of the leaf has the double structure in *Colpoxylon*, while the structure is simple in *Medullosa*, a genus allied to the Cycads, though both have lost all traces of their centripetal wood, except some vascular bundles scattered through the pith, the woody element of the stem being composed of tracheids punctate in many rows and medullary rays organized like those of the *Cycads*. He concludes that the Phanerogamic characters became gradually associated with the Cryptogamic, increasing little by little to preponderancy and finally exterminating the latter; that these changes are successively accomplished in the principal organs of the plant and in a definite order, the fruits being last to change. In effect, M. Renault suggests that the difference between the Paleozoic Lycopod group and the living Cycad is hardly more than that between the living Cycad and the typical Phanerogam. DAVID WHITE.

THE EMBANKMENTS OF THE RIVER PO.

THERE is probably no part of the world in which the action of rivers in carrying and depositing sediment can be better seen and more readily studied than in the plains of Lombardy and along the adjacent shores of the Adriatic, and no district has contributed more to our knowledge of the important subject of river action and delta building than has this portion of Northern Italy.

In this well settled country the very rapid advance of the land upon the sea everywhere has been especially remarked and could not escape the attention of the most unobservant, since, as is well known, the very town of Adria, which gives its name to the Adriatic Sea and which was a sea port in the time of Augustus, now lies 14 miles inland.

One statement concerning the chief of these Lombard Rivers, the Po, taken from chapter eighteen of Lyell's Principles of Geology, has been copied and recopied in one generation of text-books after another, a statement so remarkable that wherever met with it always arrests one's attention. It is that in which, after speaking of the action of the dykes, between which these Lombard rivers are confined in causing a portion of the sediment, which would otherwise be spread over the plains by the annual inundations, to settle in the bottom of the river channel, with the consequent necessity of from time to time increasing the height of the dykes, he says, "Hence it happens that these streams now traverse the plains on the top of high mounds, like the water of aqueducts, and at Ferrara the surface of the Po has become more elevated than the roofs of the houses."

On reading this passage one cannot but tremble for the fate of the city should the river break through its dykes, as it has already done on several occasions, and, being precipitated into the city, tear its way headlong to the sea.

A visit to Ferrara toward the end of May last served, however, to show that this danger is less imminent than might be supposed from Lyell's description.

The city of Ferrara has seen its best days; its population once numbering 100,000 has now dwindled away to less than 30,000, while great stretches of land within the walls are now quite deserted or used as kitchen gardens. The broad and ample streets and fine squares, as well as the noble cathedral, the numerous palaces and the great castle of the House of Este, however, serve to remind us of the former greatness of the city, with which are so intimately associated a number of the most distinguished names in Italian history, Savonarola, Ariosto and Tasso among the number.

The city is situated in the middle of the great plain of lower Lombardy, which so far as the eye can judge, is absolutely flat and which here is only six and a-half feet above sea level. The walls of the city, built of brick—for no good building stone is to be had in the alluvial plains in this vicinity—rise abruptly from the plain and are of no great height.

The plain all about Ferrara is very fertile, well cultivated and of extreme beauty, being intersected at regular intervals by long lines of poplars and pollarded elms festooned with vines, which also border the roads and separate the meadows and great fields of grain and hemp. The roads crossing the plains are well made and are raised considerably above its general surface, thus keeping them dry and in good condition.

The river Po, however, does not pass through the city of Ferrara, although it formerly passed near the city and in this vicinity branched, forming the Po Primario, whose mouth was at Ravenna, and the Po Volano, which debouched into the northern portion of lagoon of Comacchio. In the year 1152, however, the river broke through its dykes at Stellata, twelve miles and a half northeast of Ferrara and took a new course in the direction of the Venetian lagoons, which course, with some minor modifications, it has retained to the present time. By this change the Po Primario and the Po Volano were deprived of a great portion of their water, and the main stream now passes three miles and a half to the north of Ferrara, where it is crossed by the railway to Padua, at the little town of Ponte Lago Scuro, a busy little place, which is the chief port on the lower reaches of Po and which is connected by a bridge of boats with S. M. Maddelena, a village on the opposite bank of the river.

On approaching Ponte Lago Scuro from Ferrara the dykes which confine the river are first seen, crossing the flat country like a wall. The road at Ponte Lago Scuro is carried by a long incline nearly to the top of the dyke, the upper portion of which is cut through to allow the road to pass, and then by a steep descent on the inner side of the dyke the bridge of boats is reached, after crossing, which, by a steep rise and then a gentle descent, the plain beyond the river is once more gained.

The Po at this point is 285 yards wide, with a swift current sweeping rapidly by the boats, and the water at the time of my visit was very turbid from suspended mud, although it did not appear so turbid as the Arno at Florence or Pisa, and certainly not so muddy as the Missouri at Bismarck.

Watching it from the bridge as it sweeps by already near the sea and far from its source on Monte Viso, carrying great quantities of leaves, masses of weeds and branches of trees floating on its surface, a very vivid impression of the work which is being accomplished by the river is obtained. Although nothing in the way of actual erosion can be seen, no mountains or rising ground anywhere breaking the monotony of the plains. The long sand bars, seen from the top of the dykes, in the wider stretches of the river just above Ponte Lago Scuro, show that in flood time a large quantity of material too heavy to be carried in suspension is swept along.

The dykes or embankments which confine the river on either side are about 25 yards wide and rise in two, or sometimes three, terraces as approached either from the plain or from the river, as if a wide dyke of moderate height had just been made, along the summit of which a narrower dyke had subsequently been raised. The height of the dykes was estimated to be about 26 feet, and being well grassed over they do not present that strikingly artificial character which might be expected. An excellent road runs along the summit of the southern dyke. The dykes thus, although not so high as the majority of the houses in the villages on either side, overtop the smaller houses and outbuildings, while, standing on the bridge at the middle of the river, seven feet above the level of the stream, only the roofs and upper stories of the buildings on either side of the river can be seen.

With regard to the level of the waters of the Po as compared with that of the adjacent plains many contradictory statements have been made. The statement of Lyell that at Ferrara it was as high as the roofs of the houses was derived from Cuvier's 'Discours sur les Révolutions de la Surface du Globe,' although not quoted quite correctly, where the statement is made on the authority of M. de Prony, an Inspector-General of Bridges and Roads, who had been directed by the goverment to investigate the means of preventing the disastrous floods caused from time to time by the Po overflowing its banks.

These very old observations were subsequently shown by Lombardini in 1847 to be erroneous. This observer proved by accurate measurements that, at the time these were carried out, the mean height of the Po only here and there rose above the level of the plains and was generally considerably below it, and that even during the great flood in 1830 the surface of the river was scarcely ten feet above the pavement in front of the Palace at Ferrara (Geikie, Text-book of Geology, p. 368).

Since this time, however, these conditions have altered in a marked manner, the more recent investigations of Zollikofer having shown that in the normal condition of the river the surface of the water in the neighborhood of Ferrara is somewhat over 8 feet above the surrounding plains, while in flood time the water in some places rises from 16 to nearly 20 feet above the plain on either side (Kovatsch—'Die Versandung von Venedig'—Leipzig, 1882, p. 35).

At the time of my visit the surface of the water was certainly higher than the level of the plains, and the deep furrows in the dyke on the left bank of the river showed that in flood time the river now rises at least as high as the top of the first terrace of the embankment, which would be equivalent to the height given above by Zollikofer. That the river at times threatens to rise even higher is shown by the fact that where the upper terrace of the dyke is cut through to allow the passage of the road from Ferrara a brick wall has been constructed, so arranged that by the insertion of planks the highest level of the dyke may be maintained.

The city of Ferrara, therefore, although it might be subjected to disastrous inundation should the dyke on the right bank of the river break, is not so seriously threatened as might be inferred from Lyell's statement, and the Po, which in flood time 'hangs suspended, so to speak, over the surrounding plains,' is now much less dreaded than in times past, owing to the irrigating channels which tap it, as well as to a secondary series of lateral embankments which, placed at a considerable distance from the dykes on either side, border the whole course of the river below Cremona.

FRANK D. ADAMS.

McGILL UNIVERSITY, April, 1896.

MEASURING HALLUCINATIONS.

In Science, 1893, XXII, 353, attention was called to a method of measuring the intensities of hallucinations. The method is, in brief, as follows:

In an unsuspecting subject the stimulus R under the condition P is used to produce a sensation S. The sensation is a function of the stimulus, $S=f(R)$, and is measured by means of it. By means of appropriate adjustment of the conditions P the sensation can be made to appear just the same whether is present or not.

When R is not present, the sensation is called a hallucination; let it be denoted by the H, although the person experimented upon does not distinguish sensation from hallucination. We have thus in such cases $H=S$, and likewise $S=f(R)$, with R used measure the intensity of the hallucination. It is also evident that $H=F(P)$, and likewise (a fact seldom fully regarded in psychology) $S=F(P)$.

With this method Dr. C. E. Seashore has, under my guidance, carried out measurements of hallucinations and has just published the results in the *Studies from the Yale Psychological Laboratory* for 1895. As the fundamental idea may interest others than those reached by the *Studies*, I will state it briefly here.

It was at first intended to end every experiment in a measurement according to an absolute scale of units of energy, *e. g.*, light by reference to a standard source of illumination or to a bolometer-reaction (Langley, Mem. Nat. Acad. Sci., 1891, V, 7), sound in units of atmospheric displacement (Wien, Wied. Ann., 1889, XXXVI, 834), etc.; but it was soon decided that it was preferable to first explore the region of suggestion and hallucination with convenient arbitrary scales without waiting to reduce these scales to standards. This course has been amply justified by the results; the proper methods of producing hallucinations have been found for all the senses and the arbitrary scales have been so arranged that future investigators can repeat the experiments under exactly the same conditions, merely changing the scale. To be sure, this latter step is generally very expensive in many ways; in our case width of exploration was preferable to minuteness.

A typical case of the application of the method is found in measuring hallucinations of sound. The person experimented upon was placed in a quiet room and was told that when a telegraph sounder clicked, a very faint tone would be turned on, and that this tone would be slowly increased in intensity. As soon as he heard it, he was to press a telegraph key. The experimenter in a distant room had a means of producing a tone of any intensity in the quiet room. The apparatus for producing the tone consisted in an electric fork interrupting the primary circuit of an inductorium in the experiment room and a telephone in the quiet room (unknown to the subject), which was in connection with the secondary coil of the inductorium. The intensity of the tone depended on the distance between the two coils of the inductorium; this distance was recorded in millimeters.

In the first few experiments a tone would be actually produced every time the sounder clicked, but after that the tone was not necessary. It was sufficient to click the sounder in order to produce a pure hallucination.

The persons experimented on did not know they were deceived, and said that all tones were of the same intensity. The real tone could be measured in its intensity, and since the hallucination was of the same intensity it was also indirectly measured.

Similar experiments were made on other senses. For example, in regard to touch, a light pith ball would be dropped regularly

on the back of the hand to the sound of the metronome. After a few times it was not necessary to drop the ball. The person would feel the touch by pure hallucination.

Similar experiments were made on taste. Of six bottles two contained pure water and the other four a series of solutions of pure cane sugar—the first one-half per cent., the second ten per cent, the third two per cent. and the fourth four per cent. sugar, according to weight. A block was placed in front of them so that the observer could not see them, although he was aware that they stood near him, because he saw them when he received his instructions. It was required of him to tell how weak a solution of sugar he could positively detect.

The experimenter took a glass dropper and deposited drops on his tongue, drawing first from the two water bottles, and then from the sugar solutions, in order of increasing strength. The sugar in the solutions was detected in the first trial. Proposing to repeat the test, the experimenter proceeded as before, but drew from the first water bottle every time. The result was that when the pure water had been tasted from two to ten times the observer almost without exception thought he detected sugar.

A test on olfactory hallucinations was conducted similarly, with the result that about three-fourths of the persons experimented upon perceived the smell of oil of cloves from a pure water bottle.

In another set of experiments the subject was told to walk slowly forward till he could detect a spot within a white ring. As soon as he did so, he read off the distance on a tape measure at his side. The spot was a small blue bead. The experiment was repeated a number of times. Thereafter the bead was removed, but the suggestion of having previously traversed a cartain distance was sufficient to produce a hallucination of the bead.

The investigation was carried out in various problems of hallucination and suggestion; in each problem the work was kept up till the appropriate method of producing hallucinations was found. I cannot here go into the details of Dr. Seashore's experiments, but the fundamental idea is, I hope, clear.

The surrounding and internal conditions P were of a given character in the first experiment, namely, definite place, apparatus, expectation, etc. The sensation S resulted from R. Each repetition of the experiment produced a change in the attitude of expectation; P was consequently changing. Finally, the production of a given value of P was sufficient to entirely replace R in producing the sensation.

It is to be clearly understood that the persons experimented upon were perfectly sane and normal. They were friends or students, generally in total ignorance of the subject, who supposed themselves to be undergoing some tests for sensation. One case was found, however, of a suspicious observer who expected deception and who declared that he had waited every time till he was sure of the sensations; the results were just as hallucinatory as usual.

The value of the method and the experiments lies mainly, I think, 1, in pointing out a method of determining the portion of a sensation due to the suggestion of circumstances rather than to the stimulus; 2, in application to mental pathology; 3, in beginning a scientific treatment of hypnotism and suggestion.

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LIFE HABITS OF PHRYNOSOMA.

IN a recent number of the 'Zoölogischen Anzeiger' Prof. Charles L. Edwards, of the University of Cincinnati, gives the following interesting notes upon the habits of the horned lizard of Texas:

While living in Austin, Texas, from

May, 1892, to July, 1894, I had abundant opportunity of verifying previous observations upon the life of *Phrynosoma*, and of adding some notes that, so far as I can find, have not been given before this paper.

Phrynosoma cornutum Harlan, in Texan parlance the 'horny frog,' is easily approached under the natural conditions of its habitat, and with a plentiful supply of live flies I have had no difficulty in keeping from fifty to one hundred of them confined in vivaria for many weeks at a time. Six months of the hot, dry, Texas summer, with long days under the glaring sun, and the ground covered with a layer of fine, limestone dust, gives this species of *Phrynosoma* an ideal environment.

A review of the principal points concerning the biology of this familiar genus as brought out in the literature appended, and confirmed by myself, may be first presented. Not to go back to the original systematic descriptions of Wiegmann, Girard, Harlan, Hallowell, Bell, Gray and Blainville, or to mention the synonymy from the various catalogues of reptiles, the taxonomic needs of this paper may be served by reference to Gentry's review of the genus *Phrynosoma*.

This cunning little Iguanid is harmless, never biting its captor, and soon becoming so tame that it may be trained to work in harness pulling a toy wagon, or to eat insects from one's hand. When gently rubbed it puffs itself out, but when in fear it becomes flattened to the ground. *Phrynosoma* chiefly enjoys a dust heap, where with tail and feet flirting the warm calcareous powder over its body, or with alternate sawing motions of its sides, it quickly buries all of itself save the head, and sometimes even this part, in the dirt. While built after an awkward pattern for a lizard, and generally moving slowly, yet it can, when alarmed, run rapidly. It is very clever at 'playing possum' and, aided by its protective coloring, often escapes from an enemy.

The food of *Phrynosoma* always consists of live animals—spiders, flies and especially ants. In Texas the agricultural ant (*Pogonomyrmex barbatus*) furnishes almost exclusively the diet of the horned frog. If, however, a quantity of ants are placed with the latter in a vivarium, they soon find thin places on the apparently tough, horny armor of their enemies, and by stinging they drive the horned frogs crazy and frequently to death. While having an abundant supply of water in the vivarium, I have never seen these lizards drink, although they are said to lap up drops of dew when in natural environment. The molting and the curious habit of ejecting blood from the eyes are phenomena often observed. The statement of Böttger that a voice is absent in *Phrynosoma* must be modified, for under certain conditions of excitement it utters a sharp squeak.

This lizard has always been given as viviparous. On the contrary, it builds a nest and lays eggs therein. The only time I observed the nest-building was on June 25, 1894. The location was on a stony clay bank at the side of an Austin street. When first seen, 6 p. m., the female was excavating a tunnel at an angle of about 75° to the surface of the ground, and wide and high enough to comfortably work in. She dug with her front feet, pushing back the loose earth and bits of stone with her hind feet until this débris was quite clear of the entrance. So absorbed was she in her work that my presence did not cause any alarm. The next morning I found the tunnel neatly filled again and the lizard gone.

After carefully removing the replaced débris, the tunnel was found to be seven inches deep. At the bottom, forming an L with this tunnel, was a narrow entrance leading into a chamber three and one-half inches in diameter and two inches high,

which was quite round, except for two projecting stones. Here perfectly packed in with loose earth were twenty-five eggs, while again in a hole one and one-half inches deep, at the bottom of the tunnel, were fifteen more. Since the embryos of one of these sets were at a considerably more advanced stage, this female must have taken advantage of the excavation of another. At the time of ovulation the embryo, while at an advanced stage, is still not ready to hatch by probably some days or even weeks. This stage will be considered in detail in a later paper on the embryology of *Phrynosoma*.

Authors give the period of gestation as high as one hundred days in females kept in confinement, but while I have not complete data from coition to ovulation I believe that under natural conditions the time of carrying the eggs is much shorter. A female which had laid eggs in captivity in August, 1864, became very restless after the eggs were taken away. She tried constantly for two or three days to get out of the vivarium at the place where the wire screen had been raised to remove the eggs. Lockwood gives an instance of this maternal anxiety where a female attempts to distract the attention of an observor from her young.

LORD KELVIN ON THE METRIC SYSTEM.

THE chief objection urged in the recent debates in Congress against the adoption of the metric system in the United States was the fact that Great Britain, with whom our commerce is the largest, does not use the system. It seems, however, certain that the adoption of the system by both nations is only a matter of time, and as the question is now being considered, both by the British Parliament and our Congress, it would be highly desireable if an International Commission could be arranged so that unity of action could be secured by the two nations.

The London *Times*, whose influence has been said to be as great as that of Parliament, has recently given much space to discussion of the metric system. Of the large number of letters addressed to the editor we quote the following from Lord Kelvin as of special interest:

"In your very interesting leading article on the metric system in *The Times* of yesterday you treat, in what seems to me a thoroughly clear and fair manner, the question at issue in respect to the demand for legislation on the subject.

"While not ignoring the preference of merchants and manufacturers and scientific men for the metric system, you rightly give prominence to consideration for the convenience of the poorer classes, 'who have no great power to make their voices heard—at least in such discussions as these.' If it were true that the adoption of the metric system would be hurtful, or even seriously inconvenient, to them, that would be a strong reason against its being adopted in England. But in this respect we have, happily, a very large experience, and I believe it is quite certain that among the Germans, Italians, Portuguese, and other European peoples who have had the practical wisdom to follow the French in the metric system, all classes are thoroughly contented with it, and find it much more convenient for every-day use than the systems which they abandoned in adopting it.

"You rightly brush aside the duodecimal system as 'an ingenious mathematical exercise, but one whose figures must be read back into a decimal system before they can convey any meaning.' It seems to me, however, that you are quite right in maintaining that in ordinary every-day reckonings the shopkeeper and his customers must have halves and quarters; but I cannot go so far with you as to say 'halves, quarters and thirds.' Was any poor child ever sent to buy a third of a pound of tea? Did any

thirsty traveller, other than a mathematician, ever ask for a third of a quart of beer? It may be taken as a practical result of natural selection, permanent through thousands of years, that halves and quarters of the ordinary unit for any class of measurement are natural and convenient.

"In the metric system we find the kilogramme, half-kilogramme and quarter-kilogramme continually used in weighing. There is no obligation to always call the half-kilogramme 500 grammes, or the quarter-kilogramme 250 grammes. For smaller quantities the gramme is a thoroughly convenient measure. For distances travelled we have the kilomètre, half-kilomètre and quarter-kilomètre. For measuring cloths, ribands and tapes, in retail shops, we have the mètre and centimètre, which are thoroughly convenient and popular for all ordinary use. The centimètre (about four-tenths of an inch) is a thoroughly convenient smallest unit for most practical purposes; and for finer measurements the workman under the metric system has a great advantage in the millimètre and half or quarter millimètre over the British workman with his troublesome and fatiguing eighths, sixteenths, thirty-seconds and sixty-fourths of an inch.

"The great advantage of the metric system is its uniform simplicity, all measurements of length, area, volume and weight being founded primarily on the kilomètre. The kilomètre is very convenient for measuring great distances on the earth's surface, because a journey a quarter round the world is nearly enough 10,000 kilomètres for almost all practical purposes. If our travelling was habitually, not on the earth's surface, but along diameters through the centre, there would be some practical value in the merit discovered for the British inch by Sir John Herschel that it is approximately one one-hundred-millionth of a diameter of the earth.

"The thousandth of the French ton is the kilogramme; and the cubic decimètre, or the thousandth of the cubic mètre, is the litre, which is the common popular unit for liquid measure; so that any one who has correct weights can verify for himself his litres or other measures for liquid. This particular merit of the metric system, which, so far as I know, has not been much, if at all, noticed by your correspondents, is of very great importance in mechanics and engineering. In virtue of it the weight of any quantity of material is found in tons, or in kilogrammes, or in grammes, simply by multiplying its volume in cubic mètres, or in cubic decimètres, or in cubic centimètres, by its specific gravity; and thus a very great deal of labor which is entailed upon mechanical engineers, civil engineers and surveyors in England under the present system will be done away with when the metric system comes into use.

"But now, considering the wants and the convenience of the whole population, think of the vast contrast between the practically valuable simplicity of the metric system and the truly monstrous complexity of British measurements in miles, furlongs, chains, poles, yards, feet, inches; square miles, acres, square yards, square feet, square inches; cubic yards, gallons, quarts, pints, gills; tons, hundredweights, quarters, stones, pounds, avoirdupois (7,000 grains), ounces avoirdupois (437·5 grains), drams avoirdupois (27·34375 grains), pounds troy (5,760 grains), ounces troy (480 grains), drams apothecaries' (60 grains), &c. Looking at the question from all sides, and considering all the circumstances, I believe it will be found that the thorough introduction of the metric system, for general use in Great Britain, will be beneficial to all classes; and that the benefit will, in the course of a few weeks, be found to more than compensate any trouble involved in making the change."

NOTES ON AGRICULTURE AND HORTICULTURE.

PREVENTION OF SMUT IN OATS.

THERE is a large loss annually from smut in various crops and oats especially suffers. It was about twenty per cent. at the farm of the Ohio Station, and a fair estimate of loss for the whole United States is more than eighteen millions of dollars annually.

This smutting of the grain, as has long been known, is due to an invading fungus that produces vast multitudes of spores in the grains; in short, the grains are transformed or replaced by the fungus which in its final condition is mostly spores usually dark and dusty.

Prof. Selby shows by his experiments that the smut enters the seedling oat plant by spores adhering to the seed grain and may be prevented by the destruction of the spores attached to the oats before sowing. This may be done by immersing the oats in hot water at a temperature of 133° F. for fifteen minutes. This treatment likewise increases the vigor of the seed. It was also found that "soaking the seed for twenty-four hours in a solution of a $\frac{3}{4}$ per cent. solution of potassium sulphide made by dissolving $1\frac{1}{2}$ pounds of the salt in 25 gallons of water is equally efficient in smut prevention." Both the above methods of treatment apply to wheat, barley and other grains, with certain modifications to suit the particular cases.

BACTERIOSIS OF CARNATIONS.

BACTERIOSIS is a term now growing into general use for the disease in plants due to bacteria. There are several of these troubles caused by micro-organisms, but none more interesting to the mycologist than that of the carnation. Dr. Arthur and Prof. Bolley conjointly have issued the results of their studies in a neat bulletin (No. 59) from the Indiana Experiment Station.

This bacteriosis is widespread among carnations and while seated in the leaves checks the growth of the whole plant. The disease germs enter the plant through the stomates, punctures of insects or by dissolving a passageway in the cellulose through the action of an enzym. The methods of isolating the germs of the *Bacterium Dianthi* Arth. & Boll. n. sp. are given. A full page heliotype plate is presented of gelatine tubes and another of the appearance of a portion of a diseased plant. It is found that any variety of carnation may be affected, but weak and old plants are most susceptible. Other than members of the pink family of plants are exempt from this trouble.

Valuable practical methods of culture to prevent the bacteriosis have been found, the chief ones residing in the fact that the disease is favored by moisture. By keeping the foliage dry, by watering the soil between rows of wire netting arranged to support the plants the disease is largely prevented. The aphis should be kept off.

BYRON D. HALSTED.

NEW BRUNSWICK, N. J.

CURRENT NOTES ON ANTHROPOLOGY.

RACE AND DISEASE.

SOME interesting studies on the relations of these factors in sociology have recently appeared from the pen of Dr. William Z. Ripley, who lectures on anthropo-geography in Columbia College. One is upon the problems of acclimatization, and may be found in the March and April numbers of the *Popular Science Monthly* It displays a thorough acquaintance with the literature of the subject, and is marked by a careful weighing of the numerous discordant opinions. It cannot be said that he reaches a satisfactory decision in favor of the possibility of acclimatizing the white race in the tropics, which is the chief practical interest of the inquiry.

Another of Dr. Ripley's papers appears

in the March number of the quarterly publications of the American Statistical Association. It is upon ethnic influences in vital statistics, illustrated by a comparison of the Walloon and Flemish inhabitants of Belgium. The facts presented are interesting and from the best obtainable sources; but the complexity of the problem is enormous, and after one has excluded all other possible or probable explanations for the diversity discovered, very little is left which can be strictly called ethnic. For instance, the birth rates, the excess of male infants and the infant mortality may have quite other explanations than those connected with ethnic contrasts.

BUDDHA-LIKE FIGURES IN AMERICA AND ELSEWHERE.

In Egypt, in Greece and abundantly in France, representations of deities seated cross-legged have been found, and frequently by archæologists have been referred to as Buddhistic or Buddha-like figures. In the museum of the Trocadero, Paris, there are a number of such in terra cotta from Chiapas; and at Palenque the cross-legged divinity has been pictured by Stephens (Travels, vol. II, p. 318) and others. Of course, these have been utilized as evidence of Buddhistic influence in North America and Europe.

A severe blow at such illusions is dealt by M. H. Galiment in the Revue de l'Ecole d'Anthropologie (Feb. 15), in an article on 'the oriental attitude of divinities.' By this he means merely the ordinary oriental method of sitting which is common also to our tailors and to many non-oriental nations. This he sharply distinguishes from the religious attitude assigned to the Buddhas. In the latter the legs are crossed, and each foot rests on the thigh of the opposite leg, with the sole turned upward and in full view. This is quite different from the attitude in any of the American specimens known to me, either by observation or by copies. They are seated with the legs crossed beneath the thighs, in the ordinary sartorial position. Thus does another prop fall from the weak structure of the builders of American aboriginal culture on Asiatic foundations.

CURRENT NOTES ON METEOROLOGY.

HURRICANES IN JAMAICA.

A chronological list of hurricanes, earthquakes, and other physical occurrences noted in Jamaica between 1504 and 1880, is given by Maxwell Hall in Vol. II. of the *Jamaica Meteorological Observations* (1896). The first great hurricane experienced by the English in Jamaica was on August 28, 1712, and on August 28, 1722, another very violent one occurred, which resulted in the loss of about 400 lives and the wrecking of forty-four vessels in the harbor of Port Royal. In order that these two visitations might be remembered by the inhabitants, August 28th was appointed to be kept as a perpetual fast by the Act 9 Geo. I., ch. I., passed in 1722. On June 3, 1770, there was a smart shock of earthquake, which was immediately preceded at Cape François by a fall of 2.5 in. in the water barometer, corresponding to a fall of 0.2 in. in the mercurial barometer. Small oscillations of this character have since been noticed at Kingston as accompanying earthquake shocks.

Previous to the hurricane of October 3, 1770, a noise resembling the roar of distant thunder was heard to issue from the bottom of all the wells in the neighborhood of Kingston, twenty hours before the commencement of the storm. A ship captain who noted this fact, and who was informed that it was a prognostic of an approaching hurricane, managed to get his ship into the inner harbor in time to save her from destruction.

THE CLIMATE OF VENEZUELA.

SOME notes on the Venezuelan climate are quite in place at the present time. Three climatic zones are recognized: The *tierra caliente*, extending from sea level to about 1,800 feet, with a mean temperature of 77° to 86° F.; the *tierra templada*, reaching up to about 7,200 feet, with a mean temperature of 60° to 77° F., and the *tierra fria*, above 7,200 feet, with a mean temperature below 60° F. The heat on the northern coast is excessive, owing to the trade wind, which blows on shore there after crossing the hot Caribbean Sea. Maracaibo, which has the reputation of being the hottest place in the world, is on this northern coast, while Caracas, at an elevation of 3,000 feet above sea level, is in the *tierra templada* and enjoys a cooler and more agreeable climate. The maximum temperature is between 68° and 82° in the hot months, and 52° and 71° in the cool months. In Acarigua, south of the Portuguesa range, a temperature of 125.5° has been reached in the sun and 89.5° in the shade. The climate is, as a whole, healthy. Yellow fever prevails near the coast and in the Llanos and forests of the lowlands, and sometimes visits towns in the *tierra templada*. The higher mountains are free from it and have a very healthy climate. The foregoing facts are taken from a paper on Venezuela in the *Scottish Geographical Magazine* for April, 1896.

A QUICK VOYAGE ACROSS THE PACIFIC.

THE May *Pilot Chart of the North Pacific Ocean* contains mention of a remarkable passage recently made from Shanghai to Port Townsend by the American schooner 'Aida,' the time from port to port being only 27 days. During the greater part of the voyage the wind was between north and west, and on three days blew with the force of a whole gale. The 'Aida' started in the western half of a cyclonic depression central over Japan, and hence experienced northwesterly winds for several days. These were followed by southerly winds of considerable force, due to the approach from the west of another cyclonic storm. The last few days she had southwesterly winds from an anti-cyclone central in Lat. 40° N., Long. 135° W., this high pressure area diverting the preceding cyclone to the northward and thus preventing the 'Aida' from experiencing the northwest gales on its rear. This passage of the 'Aida' may be regarded as an excellent example of what may be accomplished by a well-found sailing vessel whose master makes the most of the meteorological conditions prevailing over the ocean, and of the information now available concerning them.

A TORNADO IN NEW JERSEY.

TORNADOES are of such infrequent occurrence in the eastern United States that accounts of them, when they do occur, are of special interest. On July 13, 1895, a distinct tornado developed near Cherry Hill, N. J., causing the death of three persons, injuring about twenty others and entailing a loss to property, livestock, etc., of about $60,000 (6th Annual Report, New Jersey weather service, 1895, 203–208). It appears that while the general characteristics of tornado action were present, such as the funnel cloud, the whirling, the roar and the thunderstorm, the usual atmospheric conditions which precede such storms were lacking. A number of curious tricks were performed by the tornado, after the usual fashion of these disturbances. In the Dutch Reformed Church, whose sides and windows were punctured with holes, a large beam was found lying across the pews, it having been blown there from outside. A splinter of wood, 15 inches long, 2 inches square at one end, and tapering to a point at the other, was found firmly stuck

into a fence post. A number of excellent photographic views accompany this report.

R. DeC. Ward.

Harvard University.

SCIENTIFIC NOTES AND NEWS.

ANNUAL REPORT OF THE GEOLOGICAL SURVEY.

The Fifteenth Annual Report of the United States Geological Survey has just been delivered by the Public Printer. It is a handsome volume of 755 pages and 48 plates, and contains, besides the administrative reports of the Director himself and of chiefs in charge of work, the following special papers:

'Preliminary Report on the Geology of the Common Roads of the United States,' by Prof. N. S. Shaler; 'The Potomac Formation,' by Prof. L. F. Ward; 'Sketch of the Geology of the San Francisco Peninsula,' by Andrew C. Lawson; 'Preliminary Report on the Marquette Iron-bearing District of Michigan,' by Prof. C. R. Van Hise, W. S. Bayley and H. L. Smyth; and 'The Origin and Relation of Central Maryland Granites,' by C. R. Keyes, with an 'Introduction on the General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau,' by the late Prof. G. H. Williams.

From these titles it is evident that the paper of most popular interest is the first one, on roads, by the versatile Harvard professor. He treats of the history of American roads, the methods of using stone in road-building, the relative value of road stones, their distribution, sources of supply, etc.; and thus makes a timely contribution to a subject which is receiving special attention in all parts of the country.

This is the last report made by Major J. W. Powell as Director of the Survey, who until recently has had charge of the work, under different organizations, for twenty-five years.

FISH CULTURE.

In a lecture on fish culture before the Royal Institution of Great Britain, Mr. J. J. Armistead, of the Royal Commission on Tweed and Solway Fisheries, thus compares the methods used in Great Britain and the United States:

The hatching apparatus which is now chiefly used in England consists of a long box, the water flowing in at one end protected by a water board or break water, which is simply to break the current and prevent it from washing away the eggs which are placed in the box. It also diverts the current and sends it down to the bottom of the box. The water passes underneath and passes out at a higher level, where we have a screen of perforated metal to prevent the escape of the little fish, and in this box is placed the hatching apparatus proper, that is, the trays or grilles upon which the ova are deposited. The grilles now in use are made of glass. We found, after trying a variety of substances, that glass is the best of anything. It gives off nothing. Wood and metal we know corrode in water, and in some waters some metals corrode very much, and a great deal of loss has been suffered by some who have used metallic trays for the purposes of incubation. The Americans like to do things, as we know, on a wholesale scale, and, not content with putting a layer of eggs upon the apparatus, they fill a basket, as they call it, half full of eggs. Then they send a current of water welling up from underneath, and of course the effect is that it flows through amongst the eggs, and they find that in due time they hatch. I have made very careful inquiries with regard to the result of the hatching of ova in this way, and I have found that the Americans are quite prepared to admit that they had a larger percentage of mortality in their metal baskets or trays than they had when they used glass grilles. They said, "We have discarded glass grilles long ago. They are too expensive." And they made use of other excuses. But, however, we find in practice that we can get far better results from these glass grilles, because, as I have said, there is nothing to contaminate the ova or do them injury. The trout eggs absorb any metallic matter which may be in the water, and become so saturated with it in course of time as to be very seriously injured. They may not be absolutely killed at the time, but it has been found that, although there is only a slightly increased mortality in hatching upon the metal, there is a greater mortality amongst the fish afterwards. They

do not live to grow up in the same way as they do when they are hatched on the glass.

RECENT CHEMICAL PROGRESS.

PROF. DEWAR lectured before the Royal Institution on April 16th, on Recent Chemical Progress. According to the report in the London *Times* Prof. Dewar dwelt especially on the great future opened out to synthetical chemistry by the employment of the temperature of the electric arc. Some of the most interesting results had been obtained from the electric furnace by the French chemist, M. Moissan, in the shape of carbides, stable bodies produced by the combination at high temperatures of carbon with various metals. Many of the carbides were decomposed by water, the hydrogen of the water combining with the carbon to form hydrocarbons. Thus with water some carbides, such as that of calcium, gave acetylene; others, like that of aluminium, gave marsh gas, while others again gave these and other gases, and what was most wonderful, liquid petroleums. It was a curions fact that many years ago Professor Mendeleef speculated that the only reason for the immense localization of petroleum at Baku was that it was being generated there by the action of water on carbides. His idea was rather smiled at then, but now it is his turn to smile. When acetylene was heated to a dull red heat it was polymerized to benzene. Benzene was the basis of all the new modern colors, and thus by three direct stages we were able to reach the nucleus of all the colors hitherto manufactured from coal-tar products. First there was the combination of lime and coke in the electric furnace; second, the decomposition of the carbide thus formed by water; and third, the transformation into benzene of the resulting acetylene by means of heat. Professor Dewar concluded by briefly discussing some of the properties of acetylene, explaining, among other things, the cause of its extraordinarily great luminosity as due to its peculiar endothermic structure.

THE MARINE BIOLOGICAL LABORATORY.

THE announcement of the Laboratory of Woodsholl for 1896 shows that several changes have been made. Prof. Bumpus has resigned the position of assistant director, which has been filled by the appointment of Prof. James I. Peck, of Williams College, who also has charge of the instruction in zoölogy. Dr. Setchell, owing to his removal to the University of California, has given up charge of the botanical department, which has been undertaken by Prof. Macfarlane, of the University of Pennsylvania. The officers having charge of original research in zoölogy include Profs. Howard Ayers, University of the State of Missouri; E. G. Conklin, University of Pennsylvania; W. A. Locy, Northwestern University; and M. M. Metcalf, the Woman's College of Baltimore. Prof. Whitman has charge of the work in embryology with the assistance of Dr. Lillie, of the University of Michigan, and Dr. Strong, of Columbia College.

The session of 1895 was unusually successful, the membership of the laboratory being 199, which was 65 in excess of the number in 1894, a regular increase having been maintained since the foundation of the laboratory in 1888. In 1895 there were 42 independent investigators at work and 21 carrying on research under supervision. In addition to the regular courses nineteen public lectures were given in 1895. The Marine Biological Laboratory is perhaps open to the criticism that the work is too much that of the laboratory and too little that of the naturalist, but this is only following the trend of biological science throughout the world. It is certain that nowhere else in America can biological research be undertaken with such pleasant and stimulating surroundings.

THE ZOÖLOGICAL SOCIETY OF LONDON.

ACCORDING to the London *Times*, the sixty-seventh anniversary meeting of the Society was held on April 29th. The report of the Council stated that the number of Fellows on January 1, 1896, was 3,027, showing a net increase of 55 members during the year. The number of new Fellows that joined the Society in 1895 was 197, which was the largest number of elections that had taken place in any year since 1877. The total receipts of the Society for 1895 amounted to £26,958 9s. 1d., showing an increase of £1,851 8s. 6d., as com-

pared with the previous year. The ordinary expenditure in 1895 had amounted to £23,460 16s. 10d., being £155 6s. 9d. less than that of the previous year. Besides this a sum of £1,649 19s. 1d. had been charged to extraordinary expenditure. Of this sum £1,149 19s. 1d. had been devoted to the new scheme of drainage for the society's gardens, and £500 to the special acquisition of a giraffe for the menagerie. Besides this expenditure, £1,000 had been dovoted to paying off the last remaining portion of the mortgage debt on the Society's freehold premises, which were now valued at £25,000 and were absolutely free and unencumbered. A second sum of £1,000 had been transferred to a deposit account. After these payments a balance £1,391 1s. 2d. had been carried forward to the credit of the present year. A new edition of the list of animals in the Society's collection, of which the last (the 8th) was published in 1883, had been prepared under the direction of the Secretary. It would, it was hoped, be ready for issue before the close of the present year. A large number of accessions to the library were reported. The number of visitors to the gardens in 1895 had been 665,326, which was greater than it had been in any year during the past ten years. The number of animals in the Society's collection on December 31st last was 2,369, of which 768 were mammals, 1,267 birds and 334 reptiles. About 23 species of mammals, 22 of birds and one of reptiles had bred in the gardens during the summer of 1895. General the Hon. Sir. Percy Fielding, Prof. Alfred Newton, Sir Thomas Paine, Mr. E. Lort Phillips and Lord Walsingham were elected into the Council in the place of the retiring members. Sir William H. Fowler was reëlected President; Mr. Charles Drummond, Treasurer, and Mr. Philip Lutley Sclater, Secretary for the ensuing year.

GENERAL.

Dr. N. L. Britton has been elected director of the New York Botanical Gardens and will resign the chair of botany in Columbia University, though he will probably remain connected with the University as professor emeritus. Prof. Lucien M. Underwood will be called to the chair of botany in Columbia University.

The Smithsonian Institution has received from the State Department notification that the Fourth Congress of Criminal Anthropology is to be held at Geneva, Switzerland, under the auspices of the Swiss government, from August 24th to 29th of the present year. The government of Switzerland has, through its minister in Washington, invited the United States to send a representative to the Congress. Dr. Thomas Wilson, curator of the Department of Pre-historic Anthropology in the National Museum, has attended two of these Congresses, and prepared an elaborate report on the Second Congress, held at Paris in August, 1889. This was published in the Smithsonian report for 1890. It has not yet been decided whether or not the United States will send a delegate this year to Geneva.

An effort is now under way in connection with the National Educational Association to bring about greater interest in the *teaching* of science than has hitherto been shown by American botanists, zoölogists, chemists, physicists, etc. The new Department of Natural Science Instruction is intended to bring together the teachers of the natural sciences who are interested in science *as a means of culture* and to stimulate thought and discussion as to how this end may best be obtained. What rôle should botany, zoölogy, chemistry, physics, etc., play in the mental development of man? In what way may the study of plants, animals, chemical compounds and physical forces be made an efficient factor in a man's mental training? When and how shall such study be made a part of a man's training? These are some of the questions which will be discussed in the Department of Natural Science Instruction in the Buffalo meeting of the National Educational Association on Thursday and Friday afternoons (July 9 and 10), led by Profs. Carhart (University of Michigan), Freer (University of Michigan), Coulter (University of Chicago), and President Jordan (Leland Stanford University). Prof. Charles E. Bessey, of the University of Nebraska, Lincoln, is President of the department, and Prof. Charles S. Palmer, of the University of Colorado, Boulder, is the Secretary.

THE Flower Astronomical Observatory of the University of Pennsylvania is now completed and preparations are being made for its dedication. Prof. Charles L. Doolittle now occupies the director's residence and with the instructor in astronomy, Mr. H. B. Evans, has commenced preliminary work. In addition to the Flower Observatory, it is proposed to erect a small working observatory on the University grounds in West Philadelphia. The building will be equipped with a transit instrument, zenith telescope and a 4-inch equatorial, which have been presented to the University by Mr. Horace Howard Furness, Jr.

THE University of Buda-Pesth in connection with its millenium celebration will confer the honorary degree of doctor of medicine on Dr. John S. Billings.

AT a recent meeting of the Board of Managers of the New York Botanical Garden, Judge Addison Brown submitted a report from the committee on plans which stated that plans for the museum building are being prepared by ten competing firms of New York architects. Two hundred and fifty-three persons, paying $10 a year each, have qualified for annual membership.

MR. T. D. A. COCKERELL, Las Cruces, New Mexico, proposes to found a biological station, and a beginning will be made this summer, if students can be found. There is in New Mexico a great abundance of new and interesting forms of life, especially among the insects, and many general problems, such as those of the life zones, can also be studied to great advantage.

THE Metric System, will be discussed by Herbert Spencer in a series of letters to appear in Appletons' *Popular Science Monthly* for June. Mr. Spencer opposes the further spread of the system, and points out the advantages of a duodecimal over a decimal system.

WE learn from the English papers that the following fifteen candidates have been recommended by the Council for election to the Royal Society: Sir George Sydenham Clarke, known for his publications on projectiles and fortifications; Dr. J. Norman Collie, Assistant Professor of Chemistry in University College, London; Arthur Matthew Weld Downing, Superintendent of the *Nautical Almanac;* Francis Elgar, Professor of Naval Architecture and Marine Engineering in the University of Glasgow; Andrew Gray, Professor of Physics in University College of North Wales; Dr. George Jennings Hinde, geologist and paleontologist; Henry Alexander Miers, known for his researches in mineralogy; Frederick Walker Mott, Lecturer in Physiology in Charing Cross Hospital; Dr. John Murray, editor of the *Challenger* publications; Karl Pearson, Professor of Mathematics and Mechanics at University College, London; Thomas Roscoe Rede Stebbing, known for his researches in natural history; Charles Stewart, Hunterian Professor of Human and Comparative Anatomy in the Royal College of Surgeons; William E. Wilson, astronomer; Horace Bolingbroke Woodward, of the Geological Survey of England and Wales, and William Palmer Wynne, Assistant Professor of Chemistry in the Royal College of Science, South Kensington.

THE first of the two annual *Converzationes* of the Royal Society was held on May 6th. The exhibits included X-ray photographs by Messrs. Swinton, Jackson and Sydney Rowland. Mr. F. E. Ives exhibited his method of color photography and Prof. Mendola gave a demonstration by means of the electric lantern of Prof. Lippmann's color photographs by the inferential method. Prof. Worthington showed photographs of the splashes produced by a falling drop of water taken with the electric spark, the exposure being less than three millionths of a second. A method was shown by which two or three thousand copies of a photograph can be printed, developed and fixed in an hour. The exhibits seem to have been largely in photography, but in addition Prof. Dewar repeated his experiments with liquid air, and the new binocular field glasses and stereo-telescopes of Mr. Carl Zeiss were exhibited.

AT the recent annual meeting of the members of the Royal Institution of Great Britain, the report of the committee stated that the property of the Institution now amounts to more than £100,000. 63 lectures and 19 evening discourses

were given in 1895. The Duke of Norfolk was elected president for the ensuing year.

D. Appleton & Co. will publish shortly, as a new volume in the International Scientific Series, *Ice Work, Present and Past*, by Dr. T. G. Bonney, professor in University College, London. It is said that in his work Prof. Bonney will give special prominence to those facts of glacial geology on which all inferences must be founded. After setting forth the facts shown in various regions, he will give the various interpretations which have been proposed, adding his comments and criticisms. He will also explain a method by which he believes we can approximate to the temperature at various places during the Glacial epoch, and the different explanations of this general refrigeration will be stated and briefly discussed.

It is reported in the daily papers that in order to carry out still further certain recommendations of the recent committee on prisons, the directors of convict prisons in Great Britain have decided that, with a view to raise the moral tone and relieve the monotony of the life of convicts undergoing long sentences of penal servitude, lectures on scientific and interesting subjects shall be periodically given, and arrangements are in progress for giving early effect to this innovation.

It is stated in the New York *Evening Post* that the British Government has determined to send two naturalists to Alaska to make a study of the causes of the mortality of the seals. Thirty thousand pups were found dead on the Pribylof Islands last year, due, it is said, to starvation following pelagic sealing. That the report of these naturalists may not be *ex parte*, and therefore inconclusive to the minds of the American people, it is desired that at least one thoroughly qualified American shall accompany them.

The Astor Library will hereafter be open till 6 o'clock p. m. Electric light is being introduced into the library in order that the alcoves may be better lighted, and this will probably lead to the opening of the library in the evening. When the new consolidated library on Bryant Park Square has been built, it is intended to open the library on Sundays as well as in the evenings, and part of the books will be allowed to be taken from the building.

The death is announced of Dr. Adelbert Krüger, director of the observatory at Kiel and editor of *Astronomische Nachrichten*. Krüger was born in 1832 and studied under and acted as assistant to Argelander, whose daughter he married. In 1862 Krüger was made director of the Observatory at Helsingfors; in 1875 he removed to Gotha and in 1879 succeeded Peters at Kiel.

The annual field meeting of the National Geographic Society was held at Charlottesville, Virginia, on Saturday, May 16. The principal exercises of the day were held at Monticello, the home of Jefferson. This was followed by a visit to the University of Virginia and other points of interest in Charlottesville. According to the program an address of welcome was made by Mayor Patton, of Charlottesville, and responded to by President Hubbard. An address by Dr. Randolf, rector of the University of Virginia, was responded to by General A. W. Greely. Addresses were also made by Postmaster-General Wilson, on 'Jefferson at Home'; by Dr. McGee, on the 'Physiography of the Charlottesville Region'; by Dr. Goode, on 'Old Albemarle in the Revolutionary Period,' and by Prof. Thornton on 'Spottiswood's Journey Across the Blue Ridge.'

The civil service examinations in New York and elsewhere are, it seems, often passed by proxy, and the Civil Service Commission following Mr. Francis Galton's recommendation, which they seem to have learned through a story of 'Mark Twain,' have resolved that, for the purpose of identification, candidates in examination for the position of fireman and policeman be required to make an imprint of their right and left thumbs upon paper.

MM. Auguste Gerardin and Maurice Nicloux report to the Paris Academy a method for measuring smells in the air due to organic vapors. By means of incandescent platinum they burn out the organic vapors and determine the decrease in volume. They have thus been able to find, for example, that the smell of

violets occupies twice as much volume as the smell of camphor. They think the method can be employed to test the hygienic condition of the air of cities.

AT the annual business meeting of the National Geographic Society the following six members of the Board of Managers were elected for the next three years: Charles J. Bell, G. K. Gilbert, D. T. Day, W. H. Dall, H. G. Ogden and C. W. Dabney.

IT is announced that the Toronto meeting of the British Association in 1897 will be opened on August 18th.

IN a letter to the Secretary of the American Metrological Society, Mr. Horace Andrews, City Engineer of Albany, states that while a change to the metric system would probably occasion more awkardness in an engineer's office than anywhere else, yet he is in favor of change. He calls attention to the fact that in many old deeds and old maps the 'Ryland' foot and rod were used; this was probably a 'Rhineland' foot, its length being 1.0345 English feet.

IT is stated in New York *Evening Post* that Dr. William W. Jacques, an electrician of Boston, claims to have solved the problem of obtaining electrical energy from coal direct. As described by himself, in his application for a patent, he has discovered that "if oxygen, whether pure or diluted as in air, be caused to combine with carbon or carbonaceous materials, not directly, as in combustion, but through an intervening electrolyte, the potential energy of the carbon may be converted directly into electrical energy instead of into heat." His electrolyte is fused caustic soda, into which he places a stick of carbon, the oxygen being supplied by pumping in the air.

ACCORDING to *Nature*, a fine series of photographs of flying bullets, both in free air and in different stages of penetrating through a pane of glass, have been taken in Italy by Dr. Q. Majorana Calatabiano and Dr. A. Fontana, of the Italian Artillery. The apparatus described is a modification of that employed by Prof. C. V. Boys, and these photographs might, perhaps, more correctly be described as skiagraphs, since they are shadow-pictures produced on the photographic plate by the light from an electric spark produced by the discharge of a condenser. The chief peculiarity of the present figures is that, in addition to the anterior wave produced by the advance of the aërial disturbance, they exhibit dark striæ just in front of the projectile—a result not previously observed, and which the authors account for by supposing that the sudden compression of the air causes condensation of moisture producing an opaque cloud. In support of this theory, it is stated that the experiments were performed in a moist atmosphere. This blurred appearance is very similar to that which would be produced by the sparks arising from an oscillatory discharge of the condenser, but the careful precautions adopted by the experimenters to prevent any secondary discharge negative this explanation.

DR. CHARLES H. JUDD, who has recently been appointed instructor in psychology in Wesleyan University, is engaged in translating Prof. Wundt's recently issued Grundriss der Psychologie with the coöperation and under the direction of the author.

WE take the following items from the May number of *Natural Science*: "Dr. K. Lauterbach, Mr. Tappenbeck and Dr. Kirsting are leading an expedition to the Hinterland of New Guinea." "Dr. Nils Holst, the Swedish geologist, is to travel for a year in West Australia under the auspices of the Anglo-Scandinavian Exploration Company." "The 'Faraday' has returned from the Amazons, bringing with her Messrs. Austen and Pickard Cambridge, who have amassed a fine collection, chiefly of Arthropoda, and including several spiders' nests. These will go to the British Museum (Natural History). Some interesting bionomic observations have been made." "In connection with Andrée's balloon exhibition to the North Pole, it is hoped to send a zoölogical expedition, under the direction of G. Grönberg, lecturer at Stockholm University, to the Norsk-öar, near Spitzbergen, from which islands the ascent is to be made. These islands have long been known as one of the richest zoölogical localities in this region. A Polish contingent

to the expedition is being planned by Dr. Roszkowski and Prince O. Hajdukievicz, who are both studying at Stockholm. If thirteen volunteers come forward, it is proposed to hire a steamer to accompany the 'Virgo,' which leaves Gothenburg with Andrée on May 1. After visiting Spitzbergen and the Norsk-öar, this steamer will return to the north of Norway to observe the solar eclipse."

An editorial article in the London *Journal of Education* calls attention to the lack of psychological laboratories in England as compared with America, and emphasizes the fact by spelling 'psychological' 'pyschological' throughout.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Thomas McKean has offered to give $100,000 to the University of Pennsylvania upon condition that $1,000,000 be collected. Mr. McKean, who is a trustee and an alumnus of the University, gave $50,000 about a year ago.

Mr. Charles M. Dalton has given the Massachusetts Institute of Technology $5,000 for a scholarship in chemistry for graduate students. Preference will be given to those undertaking chemical research applicable to textile fabrics.

Real estate and securities valued at $215,000 have been presented to the Northwestern University by William Deering, of Evanston, who had previously given the University about $200,000.

Mr. and Miss Houghton, son and daughter of the late William S. Houghton, of Boston, trustee of Wellesley College, have given $100,000 for a chapel to be erected in memory of their father.

The fourth summer meeting, conducted by the American Society for the Extension of University Teaching, will be held in the buildings of the University of Pennsylvania, Philadelphia, July 6–31, 1896. Botany, chemistry and psychology are especially well represented, five courses being offered in botany and four each in chemistry and in psychology. The lecturers include Dr. B. L. Robinson, Dr. John M. Macfarlane, Dr. J. W. Harshberger, Prof. W. P. Wilson, Prof. Byron D. Halsted, Dr. M. E. Pennington, Prof. William Freer, Prof. W. O. Atwater, Dr. F. G. Benedict and Prof. Lightner Witmer.

DISCUSSION AND CORRESPONDENCE.

THE SIGNIFICANCE OF ANOMALIES.

At a recent meeting of the Boston Society of Natural History I remarked on the want of a satisfactory explanation of certain anomalies that it is the fashion to crudely class as reversions. I referred to the occasional appearance in man of some peculiarity of a lower form, which is in no conceivable line of human descent. I pointed out further that these anomalies were not only very numerous, but included features of the most diverse groups. To account for them by inheritance we must assume that they existed in a common ancestor of man and of the animal in which they are normal, with the astounding consequence that this primitive form, instead of being comparatively simple, must have been a perfect museum of anatomical curios, which is directly contrary to the principle of evolution. I failed to receive any information, and indeed did not expect any, for I have talked on this question with many, and have written and spoken publicly on it before. Testut's great work on muscular anomalies is a case in point; the author seems to be perfectly satisfied that he has accounted for a variation if he has shown it to be normal in some animal, no matter which. If I remember rightly, Gegenbaur, at the time, commented on this point, hinting that Testut's explanation needed to be explained. Within a few years the difficulty has been more frankly acknowledged. Thus in the Robert Boyle lecture delivered two years ago, Prof. Macalister said: "I cannot see that when one finds in the limb of a kangaroo or of a sloth, or in the face of a horse, a certain form of muscle like one which occurs as an anomaly in man, we must therefore conclude that its human occurrence must necessarily be due to atavism. Indeed the more I survey the catalogue of such parts the more I am impressed with the failure of the method as a scientific mode of accounting for these anomalies, while at the same time I am filled with admiration at

the industry and ingenuity with which the process of matching has been carried on." Prof. George S. Huntington also recognizes the difficulty in his admirable paper on certain muscular variations in the Transactions of the New York Academy of Sciences. "I believe that we are right," he says, "in referring such variations * * * to the development of an inherent constructive type, abnormal for the species in question, but revealing its morphological significance and value by appearing as the normal condition of other vertebrates." But if so are we justified in calling them 'reversions?' Dr. Huntington's views do not seem to differ widely from those that I expressed in a paper on this subject in the *Naturalist*, of February, 1895. "Those very irregularities, which we call abnormal, point to a law in accordance with which very diverse animals have a tendency to develop according to a common plan." I do not need to be told that even to establish a law (and I have only hinted at one) is not in the least to show how it acts. All that I claim is that some other principle than atavism must be invoked. The pitiable abuse of it is shown in a book that I met the other day on the vermiform appendix. After stating that this is to be considered as the end of the cæcum, the author went on to remark that the rare cases of a double appendix, which are said to have occurred, are presumably to be explained by the double cæca found in many birds. Dr. Frank Baker, in the April number of the *Anthropologist*, severely criticises similar abuses.

The question is associated with another of very general importance, namely, whether similarity of structure is necessarily evidence of descent or even of relationship. One would think from certain writings that it is conclusive; but, of course, every anatomist knows that it is not. It seems that similar special organs, or arrangements of structures, occur in widely different orders in species of similar habits or surroundings. Mr. Dobson* instances a South American rodent with the habits of moles in which the arrangement of the muscles of the leg is the same as that of the true moles. This clearly points to a law which, it seems to me, the occurrence of anomalies tends to confirm. It is in the hope of having this discussed that I lay it before the readers of SCIENCE.

THOMAS DWIGHT.

*Jour. Anat. and Phys., Vol. XIX.

'PROGRESS IN AMERICAN ORNITHOLOGY. 1886-95.'

IN the *American Naturalist* for May (Vol. XXX., pp. 357–372) Dr. R. W. Shufeldt gives, under the above title, a statistical summary of the new American Ornithologists' Union 'Check-List of North American Birds,' with criticisms *passim* on various points, followed by an arraignment of the Committee which prepared it for ignoring all recent work on the classification of birds, there being no change in this respect from the 1886 edition. He proceeds to enumerate, for the benefit of this Committee and others, the various 'elaborate classifications of birds' and the various authors who have written on the taxonomy of birds, not omitting to mention, of course, those of Dr. Shufeldt. No doubt great advances have been made in the last ten years in the knowledge of the structure and relationships of various groups of birds; and while many moot questions remain, and authorities still differ respecting the propriety of many of the recently proposed changes, a few points may be considered as having been practically settled. While it might have been well enough for the Committee to have expressed its opinion on some of the questions thus raised, such a procedure, in view of the still very unsettled state of the subject, seemed not particularly called for; especially as there were practical difficulties in the way of introducing any change in the order or succession of the higher groups.

Dr. Shufeldt strangely overlooks the main purpose of the new Check List, which was not, as he seems to think, the incorporation of the various species and subspecies added during the last ten years, and the changes of nomenclature introduced during the same period, scattered through half a dozen supplements to the original list; while this was important, its main purpose was the revision of the matter relating to the geographical distribution of the species and subspecies, which the interval of ten years had rendered, in many instances, not merely imperfect, but absolutely erroneous and archaic. Yet this feature of the new edition seems to

have escaped Dr. Shufeldt's notice, so greatly is he shocked by the lack of taxonomic revision.

In all Check Lists of North American Birds, from Baird's, published in 1858, down to Ridgway's and Coues' lists of 1880 and 1882, the species are numbered in an orderly sequence; and the numbers serve an important function, they being often used in the place of the names, not only in labeling specimens, particularly eggs, but extensively in correspondence between collectors, the number serving as a convenient symbol for the name. Hence it is important that they be given the greatest possible permanency. The A. O. U. Committee recognized this fact in preparing the Check List, and devised a scheme whereby any number of interpolations could be made without disturbing the notation of species already in the list. Of course, a transposition of groups would necessitate a new notation and create endless confusion and inconvenience, for which the Committee would receive condemnation compared with which Dr. Shufeldt's strictures can be easily borne, particularly since his views on several points are not extensively shared by other equally competent taxonomers.

The greater part of Dr. Shufeldt's paper consists of a detailed comparison of the two editions of the check list, with an analysis, taking the birds by ordinal or family groups, of the changes introduced in the 1895 edition. This is a useful statistical résumé for those interested in the subject.

It is, however, not free from typographical errors, nor from others that by no stretch of courtesy can be placed in that category. For example, *Megascops flammeola idahoensis* is recorded (p. 361) as *M. a[sio]. idahoensis;* the subgenus *Burrica* is mentioned (p. 365) as *Barrica;* it is said (p. 366), 'subgenus *Parus* inserted' in the 1895 edition, whereas it is given in the 1886 edition as well; on p. 368 the statement about the Swallow-tailed Gull is the exact reverse of the truth. His method of noting changes in the status of species or subspecies tends to a wrong conception of the facts in the case. Under 'species omitted' and 'species added,' etc., he places not only species omitted or added, as the case may be, but forms whose status has merely been changed from species to subspecies, or the reverse. Thus, as in the case of *Zonotrichia intermedia*, for example, where the change is from specific to subspecific rank, the change could have been easily and correctly indicated by a formula like the following: *Zonotrichia intermedia* (1886) = *Z. leucophrys intermedia* (1895). In place of this *Z. intermedia* is placed under 'species omitted' and *Z. leucophrys intermedia* in the list of 'subspecies added;' whereas, so far as the number of forms is concerned, there is neither omission nor addition.

In a footnote to p. 364 we find the following: "The Starling (*Sturnus vulgaris*) essentially gained a place and recognition in the A. O. U. 'List' from the fact that it has been successfully 'introduced' from abroad. If this be granted, the Committee were guilty of very unscientific practice when they omitted the English Sparrow (*Passer domesticus*) from the 'List' (also *Passer montanus*), and it can only stand as an example of how far men will allow their prejudices to carry them and blind their scientific instincts." If the critic of the A. O. U. Committee had taken the trouble to refer to the 1886 edition he would have found that the Starling was introduced in the first edition of the 'Check List' on the basis of its occurrence in Greenland, and that his presumptuous criticism and moralizing about 'prejudices' were wholly without cause. Since the publication of the first edition the species has been 'introduced, by importation in numbers from Europe, and appears to have obtained a permanent foothold here—a fact it seemed worth while to mention in the second edition of the 'Check List.' No 'introduced' species has been introduced in the Check List, which is intended to be what its name purports—a list of North American birds. Of late years many species of foreign birds have been 'turned out' in various parts of the United States and Canada, but with what results it is impossible as yet to determine. Dr. Shufeldt will find, however, in the 'Abridged Edition' of the 'Check List,' published in 1889, a list of 'Introduced Species,'' ten in number, which at that time were known to breed in this country in a wild state. But this list forms no part of the Check List proper.

The above reference to the Starling in Dr. Shufeldt's paper, taken with other passages in the same article, clearly reveals the animus of his critique.

J. A. ALLEN.

'WHAT IS TRUTH?'

In all our speculations concerning nature what we have to consider is the general rule. For that is natural which holds good.

Aristotle, Parts of Animals III., II., 16.

Knowledge is a double of that which is.

Mr. Bacon in Praise of Knowledge.

Nature means neither more nor less than that which is.

Huxley, VII., p. 154.

If the author of the letter on 'The Material and the Efficient Causes of Evolution' (SCIENCE, p. 668), will refer to an article which the Editor asked me to give him, and printed in SCIENCE in February, 1895 (Vol. I., No 5, p. 125), I think he must admit that I, at least, have not committed the blunder which he lays to the charge of certain unspecified 'Neo-Darwinians' and 'Neo-Lamarckians,' and that there is no just *cause or reason* why my name should be dragged into print in this connection.

However, I heartily agree with him that rigorous exactness is necessary in the use of philosophical language; and I also agree with him that, when no qualification is used, or implied, the English word *cause* should mean 'that which produces a thing and makes it what it is;' although it is one thing to define a word and quite another thing to show the existence of any corresponding reality.

As I am advised by this writer to consider Aristotle and be wise, I refer the reader to the passage I have put at the top of this letter, for it shows that this great naturalist is in accord with Bacon and Huxley in the opinion that our business in this world is to learn all we can of the *order* of nature, leaving to more lofty minds the attempt to find out what it is that 'produces a thing and makes it what it is,' and every other 'necessary condition of truth' except evidence.

This correspondent says the word conceive is not used with precision in my assertion that, evidence seeming adequate, I believe things which I cannot conceive. As Huxley has never been accused of inexactness in the use of words I call attention to the following passages which show that this cautious thinker also believed what he could not conceive.

"I *cannot conceive* how the phenomena of consciousness are to be brought within the bounds of physical science," IX., III., 122.

"I *believe* that we shall, sooner or later, arrive at a mechanical equivalent of consciousness, just as we have arrived at a mechanical equivalent of heat," I., VI., 191.

W. K. BROOKS.

MAY 4th, 1896.

THREE SUBCUTANEOUS GLANDULAR AREAS OF BLARINA BREVICAUDA.

TO THE EDITOR OF SCIENCE: Though the subcutaneous glands in *Soricidæ* have received much attention, these structures are not so well known in all details that further observations on the subject can be considered superfluous.

In examining perfectly fresh individuals of the common short-tailed shrew, *Blarina brevicauda*, taken in midwinter, when glandular development or activity is presumably less evident than it becomes during the rut, I find three large glandular areas—a lateral pair and one infero-median.

On each side of the body, midway between the fore and hind limbs, may easily be recognized a glandular area, half an inch long and one-half as wide, in part overlying the posterior border of the thorax, and thence extending over the abdomen. This is observable without dissection; for, on blowing aside the long hairs which cover it, the space appears to be naked, though it is in fact clothed with short adpressed colorless pelage, like that on the dorsum of the manus. Small flakes of the inspissated secretion may be noticed; but the glandular orifices are too minute to be made out, even with a hand lens, though these may become more readily discernible at another season. Nor is any musky odor perceptible in the present specimens.

The third glandular area of this shrew is larger than the lateral ones, and this is the fact to which I may direct particular attention. This additional patch is situated on the median line of the belly, opposite the lateral tracts, and

extends three-fourths of an inch caudad from the end of the sternum. In outward aspect this tract is identical with the others. On raising the skin the glandular structure is very evident; it is the same in appearance, under the lens, as that of the lateral tracts, but thicker as well as more extensive.

All three tracts are strictly subcutaneous, and come away from the subjacent parts when the skin is raised. They are supplied by large cutaneous vessels, the ramifications of which are conspicuous beneath the integument. This vascularity reddens the minutely granular texture of the glands, which a low magnifying power discloses. The three areas appear alike in both sexes.

ELLIOTT COUES.

WASHINGTON, D. C., May 7, 1896.

INSTINCT.

EDITOR SCIENCE: It seems to me that it would be well to keep the issue with which this discussion started in view, and then the direction in which the truth lies will be clearer. Nothing could be more explicit that the statement by 'The Writer of the Note' in SCIENCE of February 14th, which was this: "A chick will peck instinctively, but must be taught to drink. Chicks have learned to drink for countless generations, but the acquired action has not become instinctive."

In other words, the view that eating is instinctive and drinking is not, was that taught by Prof. Morgan and endorsed by 'The Writer of the Note' in a subsequent communication. Feeling that an important truth was being imperilled, I advanced facts to show that such a view was untenable. This was followed by the recital of additional facts by others, so that it was plain to myself—more so than ever—that such a theory as that first advanced was not sound. I was aware that all three of the writers supporting this view were in accord, constituting a sort of trinity in unity; there was, nevertheless, a great lack of harmony which seemed to be owing to the somewhat important defect that their views were not endorsed by Nature.

Now, to my surprise, Prof. Baldwin claims that I have missed the real point which he takes to be that an instinct may be only 'half congenital,' and cites this drinking of chicks; but according to the above quotation drinking is not instinctive at all, so that it looks as if the shoe was on the other foot.

In 1894, in a paper read before the Roy. Soc. Can. on 'The Psychic Development of Young Animals,' published in the Proceedings of the Society for 1895 and a copy of which was forwarded to Prof. Baldwin, I emphasized the conception that instinctive acts are *never perfect* at first, or, as Prof. Baldwin would prefer to say, are only partially congenital, though whether such an expression as 'half congenital' is a valuable addition to the English language, I doubt. Now it would be strange that I should alter my own views without noting the change, and miss the point in a matter which I was, I think, the first to emphasize; in fact, I have in this very correspondence in SCIENCE urged this view—the imperfection of instincts. If Prof. Baldwin and those he professes to interpret will grant that eating and drinking in chicks are instinctive; that both alike are imperfect at birth; that congenitally the chick is in the same condition to all intents and purposes as regards eating and drinking, he will, I believe, be in accord with the facts, and we shall all agree that the much overlooked imperfection of instincts is well illustrated by the subjects under discussion, but I should like to add, universal in its application, though in varying degree, the imperfection being in some cases not very obvious to our inadequate observation.

But in discussing evolution I feel that we are on a different plane. Here the appeal to facts is of a much less decisive character.

I have been trying since reading Prof. Baldwin's letter in SCIENCE of May 1st, in reply to my own, to ascertain his real views in regard to evolution, and have some hesitation in deciding whether I really grasp his meaning or not. However a few concrete cases may make matters plainer. A and B are, let us suppose, two individuals that survive because they can and do adapt to the environment; X and Y die because they cannot; or in Prof. Baldwin's terminology, A and B adapt to their 'Social Heredity' constituting 'organic selection' which is ontogenetic or affects the individual. But the survival of individuals specially adapted affects the race or phylum. But surely an indi-

vidual adapts to an environment ('social heredity') because of what he is congenitally. In the language of evolutionists this is survival of the fittest or natural selection, though Prof. Baldwin seems to think he has introduced a new factor in his 'social heredity.' The name is new and to my mind objectionable, as there is no real heredity; the idea is not.

Ordinary people express themselves by saying that we become what we are because of 'education,' 'circumstances,' etc. We say, "The man is the product of his age."

People tend to believe too much in the power of education, circumstances, etc., and too little in heredity; hence all sorts of cures for deep-rooted evils are ever welcome. But we find that the changes wrought by 'social heredity' are very much on the surface, and in consequence there may be but little outcome from these effects, possibly none in some cases, in heredity, as ordinarily understood, which does not, however, contravene the Lamarckian or any other well recognized principle of heredity or evolution. To return to the concrete: A and B have offspring, differing slightly from themselves. The 'social heredity' has had little effect, therefore, on the race; in the case of the lower animals, much less than in the case of man, possibly, and if the offspring C and D be placed in widely different environments the slight extent to which they have varied (congenitally) will be all the more evident.

A Lamarckian explains these variations, such as they may be, by the influence of the use and disuse of parts, and evolutionists of other schools in other ways. Prof. Baldwin misapprehends, I take it, the sense in which I employed the term 'use' in the phrase which he quotes from my last letter. The Lamarckian sense was that intended.

I must repeat that, after reading a good deal of what Prof. Baldwin has written on this aspect of evolution, it still seems to me that while he has with new terminology set forth old views in a new dress that there is really no new principle or factor involved. I do not, of course, consider such writing without special value, though it may sometimes be provokingly difficult to understand from the new technicalities employed, for the relative parts played by heredity and environment in the make-up of each individual is an interesting and practically very important problem.

If I have failed to understand Prof. Baldwin fully and so to appreciate his views at their full value on the score of originality, I regret it. However, it is likely that others are in the same case, and I venture to suggest that the remedy for our denseness, if such it be, is to be found in a specific and concrete treatment of the subject.

WESLEY MILLS.
McGILL UNIVERSITY, MONTREAL.

NOTES ON PERCEPTION OF DISTANCE.

IT appears to me that the best *data* for determining the psychological elements in the perception of distance, as I suggested some time since in SCIENCE *apropos* of mountain climbers, is to be derived from those men of mature and reflective mind who, finding themselves in very strange surroundings, are compelled to learn a new language of distance. From them we can obtain direct evidence of what passed in their consciousness, an evidence thus far superior in value to the indirect judging from the action of infants or young animals, or even the meager and few reports of the blind who have suddenly received sight. Even supposing a blind genius for psychological analysis to be suddenly given sight, the fact that an absolutely novel and complex experience was produced which included much else than mere perception of distance, as light, color, form, would tend to make his evidence to some extent unsatisfactory. For the best results in the study of perception of distance we must then find it in course of formation with individuals sufficiently educated and reflective to give some account of their experience. Even then the forming perception may be so instinctive a process that the elements may not be clearly discernible. For instance, Mr. Casper Whitney in the strange surroundings of the Barren Grounds had to learn a new form of distance which he thus describes in *Harper's Magazine* for April, 1896, (p. 724): "I began my first lessons in Barren Ground distance-gauging by guessing the yards to a stone and then pacing them off. I was not only astonished at the discrepancy between

my guess and the actual distance, but oftentimes by the size of the rock when I reached it. A stone which looked as large as a cabin at four or five hundred yards would turn out to be about as big as a bushel basket. I found much difficulty in overcoming the tendency to exaggerate distance, though the Indians apparently were not so troubled." In response to my inquiry, he further writes: "When I got so I could judge the distance with comparative accuracy, it was simply that I had to accommodate myself to the new (to me) size of rocks at those distances." From which it is plain that the newly determined distance by pacing did not alter the apparent size of rock, the apparent size is simply interpreted for a new distance value. He says to himself, "that appearance means not as I might before have judged, but so much more or less distance." In other words there is here no judging from sense of accommodation or muscular sense of any kind, because that is unaltered, the image of the thing seen being constant as to size and appearance. Distance for Mr. Whitney seems to be purely a judgment, more or less revised by actual pacings, of fixed visual appearances.

Another point on the perception of distance was suggested by James (Psychology, II., 213): "I cannot help thinking that anyone who can explain the exaggeration of the depth sensation in this case (inverted vision) will at the same time throw much light on its normal constitution." This suggests whether bats which habitually hang head downwards would not have distance lengthened by erect vision. I do not know whether this could be tested by bringing certain foods to the attention of such animals at varying distances for inverted and erect vision. I found by some simple experiments upon myself and also upon a friend that lying down, with the head in horizontal position, distance was shortened, but I was not able to test at what angle toward inverted vision distance first began to lengthen. If not already tried, it might be useful for some of our psychological laboratories to set up a tackle, so that a person might be revolved through the whole circle, and the effect on perception of distance noted at all angles. It would also be well to test whether inverting the object looked at disturbed the sense of distance. I got no result in this matter by looking at objects at the end of a long hall.

HIRAM M. STANLEY.

LAKE FOREST, ILL., April 27.

THE MAMMOTH BED AT MOREA, PA.

TO THE EDITOR OF SCIENCE: The following interesting section was found on the glaciated outcrop of the Mammoth (E) bed at Morea, Pa., within one mile of the farthest southern limit of glaciation, and from 20 to 25 miles south of the moraine of Lewis and Wright. The measures are nearly vertical and form a narrow and deep basin. A section taken on the bed gave:

(a) Till of sandy, clayey nature, with burden of Pottsville conglomerate and varying sandstones, and with irregular lenticular patches of clean reddish clay of small extent. The solid burden is angular and sub-angular, and not polished nor striated. In some cases boulders 5 feet thick occur. Total thickness, 6 to 10 feet.

(b) Crushed anthracite, bright and firm, shipped to market. This is readily scraped up with the fingers. In places to the north hundreds of tons of this crushed coal have been sold. When we realize that this is under a sandy till we can estimate the comparative recency of glaciation. In some places this layer will reach 18 inches in thickness.

(c) Rotten anthracite with angular specks of firm slate from coal. Thickness $\frac{3}{4}$ inches.

(d) Sandy clay, usually grayish, but sometimes clear red or yellow. It bears rolled and angular quartz and slate pebbles, pieces of anthracite, but little anthracite dust. Thickness 1 inch.

(e) Crushed anthracite, firm and bright, like (b). Thickness $\frac{1}{4}$ to $\frac{3}{4}$ inches.

(f) The glaciated surface of the outcrop of the bed. Soft and fully rotted so as to be dull, like black chalk, and easily cut by the fingernail. Thickness $\frac{3}{5}$ of an inch.

(g) Solid and bright anthracite of the bed.

On comparing unglaciated or protected outcrops we find (f) measuring many feet in depth. We find here that the amount of decomposition of solid coal since glaciation is $\frac{3}{5}$ of an inch.

The presence of the layer (d) is peculiar between two layers of crushed anthracite which are bright and fresh.

The solid state of the coal is analogous to the similar state of the slate in the small quarry near Siegfried, where workable slate is quarried immediately under glacial gravel. Both are on the line of farthest ice extension—of earliest extension—and speak of its recency.

EDWARD H. WILLIAMS, JR.

LEHIGH UNIVERSITY,
May 11, 1896.

A METEOR.

TO THE EDITOR OF SCIENCE: A few days ago I observed a meteor of such size as apparently to merit record. At 7:30 p. m. of May 9th the object was first seen in the twilight descending in a straight course toward the northwest at an angle of about 20° with the plane of the horizon, moving rather slowly and shining brilliantly with a greenish light. It very soon after burst into numerous fragments, the position at rupture bearing about 30° west of south from the end of the Norfolk and Washington steamboat pier at Alexandria, Va., and being at an elevation of about 10° above the horizon.

THOS. L. CASEY.

X-RAY PHOTOGRAPHY BY MEANS OF THE CAMERA.

I HAVE recently succeeded in producing X-ray pictures, reducing them in their linear dimensions to one-fifth the size of the object. The method used was to produce on a tungstate of calcium screen the shadows of the object, the screen with its contents being then photographed by means of the camera in the ordinary way.

The photographs thus obtained reveal the details more clearly than the eye can see them on the screen, and, in fact, reveal details not visible to the eye.

There is some advantage in this method over that usually employed. The photographic plates may be made of reasonable size for large objects. The pictures gain somewhat in definition, as penumbral effects are reduced. The disadvantages are the difficulty of accurately focussing the faint images on the ground glass of the camera, and the longer time of exposure needed to bring out the picture. I think it probable that these difficulties may not be very serious to those possessing the best facilities for making further study in this direction.

FRANCIS E. NIPHER.

WASHINGTON UNIVERSITY,
ST. LOUIS, May 11, 1896.

THE ROTATING CATHODE.

SINCE writing an account of my observation on the rotation of the cathode disc (p. 750) it has occurred to me that a circular or elliptical vibration of the cathode wire might possibly account for the observed effect. The tube on which the observation was made has been cracked, and now ceases to give the result, nor am I able to impart rotation in one direction only to the disc by familiar mechanical means that could have existed in the tube. The observation is one of such great interest that I think I should suggest the above possible explanation, which had not sooner occurred to me, in order to prevent experimenters from going on what may be a wild-goose chase. FRANCIS E. NIPHER.

MAY 13.

SCIENTIFIC LITERATURE.

The Principles of Museum Administration. By G. BROWN GOODE, LL. D. (Reprinted from the Annual Report of the Museum Association, 1895.) York, 1895. Pp. 73.

"The degree of civilization to which any nation, city, or province has attained, is best shown by the character of its public museums and the liberality with which they are maintained." The above sentence—the concluding sentence of the paper before us—sets forth in striking phrase the importance of the subject with which the paper deals. Superlatives are in general things which a cautious man views with suspicion, and it may well be doubted whether any one index of the state of civilization can be said to be the best. But that museums afford one of the most trustworthy indices of the progress of civilization cannot be doubted. The indication which they afford is decidedly flattering to our generation; for this is certainly preëminently the age of museums. In the number of museums, large and small, general and special, in the munificence with which they are sustained and endowed, in the knowledge,

taste and skill displayed in their housing and installation, the latter half, and especially the last quarter, of our century marks a prodigious advance.

It is rather remarkable that, while so much of thought and labor has been expended upon museums, and so much has been written upon various special questions connected with their administration, hitherto no attempt has been made to give a compact, systematic and comprehensive formulation of the principles of museum administration. That desideratum is admirably supplied by Dr. Goode's little treatise. No more competent hand could have essayed the task. Graduated from Wesleyan University a quarter of a century ago, Dr. Goode served an apprenticeship of a few years in the administration of the little museum of that institution, and displayed from the beginning the scientific and administrative ability which was soon to find an adequate field in the National Museum. To his genius is largely due the rapid advance in methods of installation, labeling and general administration, which has given the United States National Museum a rank among the foremost, not only in the wealth of its material, but also in the excellence of its arrangement. In the study of museum administration, Dr. Goode has made himself familiar with most of the great museums of the world, and with many of the most important of the great expositions of the last quarter-century. On this subject, therefore, he speaks 'as one having authority.'

Within the compass of about three score and ten pages he has formulated the general principles of the relation of the museum to other institutions and to the community, the classification of museums, the preservation, preparation, installation, labeling and use of the materials of which the museum is the custodian. These principles are often stated in the sententious form of aphorisms, many of which deserve to become maxims for the guidance of museum workers. The author finds room, however, to illustrate the subject by brief but exceedingly interesting notes on many of the leading museums.

The sections of the paper treating of the general relations and classification of museums have been published in Science, August 23, 1895, and January 31, 1896. It is therefore superfluous to give any criticism on those portions of the work. The more technical parts of the work, referring to the treatment of specimens, labeling, and installation in general, are of special interest to museum workers.

In the section on specimens, emphasis is placed on the idea of the limitation of every museum to a definite plan and scope. The authorities of a museum, instead of collecting with a dragnet all objects that may be of interest to anyone, should decline to receive specimens or collections of specimens not germane to their plan. In the interest of this limitation and specialization, the policy is advocated of extensive transfers of material from one museum to another by exchange or gift. The doctrine is undoubtedly a sound one, though it is easy to see that, in the case of small museums with limited endowments, dependent for their maintenance and progress on the good will of various benefactors, the doctrine cannot be rigorously put in practice. In the same spirit it is urged that not all the specimens belonging to any museum should be exhibited. The exhibition series especially should be made to conform to a definite plan. The series should be symmetrical, and superfluities should be rigorously excluded. This rule, unquestionably sound in principle, will naturally be subject to some modification in practice. The distinction in purpose and in administration between the exhibition series and the study series is admirably formulated.

The subject of labels is treated very fully and satisfactorily. Emphasis is placed on the value, in the exhibition series, of somewhat elaborate descriptive labels—a means of popular instruction which is admirably exemplified in the National Museum.

We are tempted to copy a few of the pithy aphorisms in which the paper abounds.

"A finished museum is a dead museum."

"It is the duty of every museum to be pre-eminent in at least one specialty."

"A museum officer or employé should never be the possessor of a private collection."

"An efficient educational museum may be described as a collection of instructive labels, each illustrated by a well-selected specimen."

"To complete a series, any specimen is better than none."

"A copy, model or picture of a good thing is often more useful than an actual specimen of a poor one."

"Restorations made in such a manner that the part restored is not at once distinguishable are unpardonable."

"A label (in the exhibition series) should answer all the questions which are likely to arise in the minds of the persons examining the object to which it is attached."

Dr. Goode's critical notes on various museums, introduced as illustrations of the principles discussed, are so interesting as to suggest that the author would render the scientific public a further service, if he could find time to expand this little pamphlet into a moderate-sized treatise on the museums of the world and their administration.

WM. NORTH RICE.

Spectrum Analysis. DR. JOHN LANDAUER. Brunswick, Fred. Vieweg & Sohn. 1896.

This handbook of some 175 pages is substantially a reprint of the author's article upon Spectrum Analysis, which appeared in the 'Handbook of Chemistry' of Drs. Fehling and Hell. Though now somewhat enlarged, it still treats more particuiarly of the chemical applications of the subject. A brief historical introduction, covering the time from Melville to the present day, is followed by tolerably complete descriptions of instruments for obtaining and examining the various spectra. No attempt is made to develop the theory of any of the instruments considered. The conditions affecting the character of emission and absorption spectra, and the empirical formulæ which have been suggested to express the relation between the lines and groups in the spectra of different elements are also touched upon, and then follow tables of wave-lengths of various metalic spectra. These embody the recent work of Kayser & Runge, Rowland and others, and all wave-lengths are expressed in Rowland's scale. Rowland's (1892) table of solar wave-lengths is also given, and the principal astronomical applications of spectroscopy are briefly treated in some fifteen pages at their end. Throughout the book copious references are given to original papers, etc., the whole forming a fairly complete resumé. The English student will find the German unusually clear and concise.

C. E. M.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, APRIL–MAY.

The Magmatic Alteration of Hornblende and Biotite: By HENRY S. WASHINGTON.

It is well known to petrographers that these minerals, under some conditions, tend to alter into a granular mass of augite and magnetite. The causes of this alteration are here discussed. After reviewing current theories, including that of Zirkel, the author proceeds to develop his own views. He finds that this alteration is most common in the intermediate group of volcanic rocks. He also finds it rare in the plutonic rocks. From the latter fact he infers that conditions of slight pressure are favorable to the changes. The theory proposed is that hornblende and biotite crystals are formed at an early (intratelluric) stage of eruption under conditions of great pressure, and probably in presence of mineralizers. As they approach the surface in the course of an eruption the pressure diminishes, leaving the temperature still high until a point is reached where the substance is no longer stable. Here a molecular change is begun which induces a molar change, so that the chemically and physically homogeneous hornblende or biotite becomes the heterogeneous granular aggregate of augite and magnetite. The origin of the augite andesites is then discussed in the light of this theory.

On the Origin of the Chouteau Fauna: BY HENRY SHALER WILLIAMS.

In a former number of the *Journal of Geology* the origin of this fauna was discussed by Stuart Weller. In the present paper the author dissents from two opinions therein expressed (1) that the Chouteau fauna was contemporaneous with the Chemung fauna of New York, and (2) that it arose by the mingling of a fauna which in the Devonian was represented by the Hamilton in New York and the general Devonian fauna of Europe represented by the Middle Devonian of Iowa and British America. Three

reasons are given (based on the study of the faunas themselves) for thinking the Chouteau was later than the Chemung. From a similar study, the author concludes that there is not at hand sufficient evidence of the composite origin of the fauna in question.

North American Graptolites: By R. R. Gurley.

The present paper is a continuation of one in the January-February number of the *Journal.* The vertical range of graptolites is quite fully discussed and tables are given showing the horizon and geological range of each species so far as the facts are known. The value of these tables is much enhanced by references to the original sources of information in a large number of cases. The author finds that graptolites may be clearly traced to the beginning of the Carboniferous period, and he thinks it likely that allied genera lived through the Paleozoic.

Deformation of Rocks, II., An Analysis of Folds: By C. R. Van Hise.

Folds are divided into simple, composite and complex. The author compares a rock fold to a wave of the sea, each large wave having superposed on it waves of the second order, these having waves of the third order, etc. Thus while the forces producing them are different, the complexity of the two are comparable. Various forms of folds are figured, and the relation between them clearly stated. Simple folds may be united to produce a great variety of composite structures, anticlinoria and synclinoria. These may be normal or abnormal and upright, inclined or overturned. As to abnormal composite folds, several factors modify the result. (1) Readjustment between the beds; (2) the great strength of the older rocks; (3) decreasing lateral stress with depth; (4) the position of the fold in the group of rocks folded. Complex folds are folds considered in three dimensions. This complexity may be due to differences in thickness and strength of beds in different places, unequal thrust on different parts of the border of an area, and to the fact that thrust may be in two or more directions. A number of practical directions are given for discovering and interpreting in the field the structure of complex folds.

C. R. Van Hise continues the 'Summary of Current Pre-Cambrian North American Literature.' S. Weller contributes a review of Williams' 'Geological Biology.' A long list of the publications recently received closes the number.

D. P. N.

SOCIETIES AND ACADEMIES.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, APRIL 28, 1896.

(1) *April recess excursion to the Middle Susquehanna, Pa:* By W. M. Davis.

The special object of this excursion was to study on the ground the deflected tributaries of the Susquehanna in Union and Snyder counties, Pa., and to determine their bearing on the hypothesis that the Susquehanna was superposed by flood plaining on the two synclines of Pocono sandstone in Dauphin county at a late stage in the Cretaceous cycle of denudation. (See Rivers and Valleys of Penna., Nat. Geogr. Mag., I, 1889, 241.) Spruce run and Buffalo creek, Penn's creek and Middle creek were examined; Penn's creek being the most significent, as it abandons a well-defined limestone and shale valley and turns south through ridges that surmount by a moderate measure the Tertiary peneplain of the region. These various streams cannot be regarded as antecedent to the time of mountain folding, for they are systematically placed with respect to the Susquehanna; they cannot be regarded as adjusted to the structures of the region, for they stand in most diverse relation to resistant and weak strata and to anticlines and synclines; their systematic southward deflection suggests the influence of an ancient flood plain of the Susquehanna that was formed on a peneplain of the past, of just the same kind as the influence exerted by the growing flood plain of to-day at Selin's Grove, where Penn's creek, after approaching within half a mile of the main river, has to flow four miles southward along the inner border of the plain before mouthing. Admitting that the deflection of the several streams was caused by flood plaining, this is shown to have been ancient, not only by the relation of Penn's creek to the low ridges that surmount the dissected Tertiary peneplain, but also by the imminent readjustment of some of the deflected streams by longitudinal subsequent streams that are growing along weak

strata from the main river; thus Penn's creek is almost captured by a longitudinal subsequent stream that enters the Susquehanna at Winfield; North Mahantango creek is likewise nearly diverted by a longitudinal subsequent branch of Middle creek that flows by Freeburg; and perhaps the direct longitudinal course of White Deer creek, further north, may be explained as a return to its normal attitude; its former southward deflection being suggested by the occurrence of a large number of Medina boulders on the col by which it is now divided from a south-flowing, transverse branch of Buffalo creek.

Among numerous points of interest noted during the trip may be mentioned: The superb view of the Delaware watergap, deep cut in level-crested Kittatinny mountain, as seen from the edge of Pocono plateau; the monotonous surface of this plateau, over 2,000 feet above tide, nearly stripped of its timber, almost uninhabited, and yielding little more than the winter ice crop of its numerous ponds; the alluvial fans, locally known as 'bulges,' formed on the low valley floors beneath various notches in the Medina ridges of the Seven mountains, one fan at Glen Iron having a radius of half a mile and a height of about three hundred feet, now somewhat trenched by its stream; the Pocono synclinal coves west of the Susquehanna, opposite Millersburg and Dauphin; the long straight boulder-strewn valley floor of Stony creek, east of the Susquehanna between Second and Third mountain, the boulders having crept down from the crests of Pocono and Pottsville sandstone and conglomerate, producing an irredeemable veneer over the otherwise fertile Mauch Chunk red shales; and the immediate transition from this uninhabitable valley to fertile fields on passing through Fishing creek gap to the more open country between First (Blue) and Second mountain.

(2) *April recess excursion to Gay Head, Martha's Vineyard:* By J. B. WOODWARD.

T. A. JAGGAR, JR.,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Section of Astronomy and Physics on May 4th Prof. A. M. Mayer presented a paper on a heliostat with small mirrors, giving an intense beam of light and forming an image at its focus. It consists in mounting a convex lens so as to concentrate the beam of sunlight upon one surface of a total reflection prism, the lens being mounted to rotate upon a polar axis so as to keep the sunbeam continually upon the mirror. A negative lens near the prism renders the beam parallel again. A second total reflection prism sends the beam in any desired direction. The advantages of this heliostat are a very powerful beam of light which can be made to emanate practically from a point, and from which the heat rays have been almost entirely absorbed by its passage through the various pieces of glass. It is especially adapted to work with the solar microscope and experiments on the interference of light. The paper was discussed by Prof. R. S. Woodward.

The following notes were presented by Mr. Wallace Goold Levison. (1) On photographs of Geissler and Crookes' radiant matter tubes.

Mr. Levison presented a very interesting series of photographs of Geissler and Crookes' tubes taken by their own light. Many of these showed very beautifully the stratification in the Geissler tubes and the difference between the phenomena at the anode and at the cathode. He also showed a series illustrating the disturbances in the stratification produced by plunging the cathode to various depths in water. The photographs of the Crookes' tubes showed not only the fluorescent spot opposite the cathode, but also very distinctly the pale bundle of cathode rays which are almost invisible to the unaided eye. (2) In this connection Mr. Levison pointed out the resemblance between the succession of colors with varying pressure in Geissler tubes and the color variation in the aurora, and suggested that the experiments described bore out the idea that the aurora is an electric discharge through the atmosphere at various heights and pressures. A possible connection between these phenomena and the solar corona and comets was also pointed out.

The third note was the description of simple apparatus for obtaining X-ray photographs by long exposure with small (6-inch) induction coil and four Bunsen cells. The fourth note

was descriptive of certain plates which were exhibited appearing to indicate a magnetic action on photographic plates. These are called magnetographs and were made by placing various objects directly on the photographic film and suspending a magnet in front of them. No satisfactory explanation or theory of the results has been given. Fifth note: In conclusion, Mr. Leviston pointed out certain causes which, in his opinion, might account for the deterioration of photographic plates, suggesting among other things X-rays from unexpected sources, terrestrial magnetism, plant or fungus organisms, and gases, such as sulphuretted hydrogen, penetrating the boxes and injuring the plates. He suggested that the test should be made by enclosing the plates in soldered metal boxes. These notes were discussed by Profs. Mayer, Hallock, Van Nardroff, and others.

By permission of the Section Mr. C. C. Trowbridge read a paper entitled 'The Use of the Hair Hygrometer,' which will be published in this JOURNAL.

W. HALLOCK,
Secretary of Section.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, APRIL 14.

IN connection with the presentation of a collection of recent and fossil Strombidæ Mr. H. A. Pilsbry discussed the ancestry of Strombus Costata and Melongena subcoronata, their relations, fossil species being illustrated by large suites of intermediate forms.

Mr. Jos. Willcox commented on the influence of environment on the species as illustrated by specimens presented. It was apparent that those from the southern coasts of Florida swept by the Gulf Stream were all of a dwarfed type.

Mr. Benj. Sharp related the plentiful occurrence of a tetenophore, Mneopsis Ludyi in a fresh water pond near Nantucket. The embryos had been swept in by an accession of salt water and had accustomed themselves to their new environment. The species did not, however, persist in the pond in consequence probably of the severity of the winter. Specimens of the species referred to were beautifully preserved in a two per cent. solution of formaline.

Mr. Pilsbry announced the finding, by Mr. Chas. Johnson, for the first time, in the Eocene of Texas, of a representative of the genus scalpillum. It is a new species for which the name Chamberlaini was proposed, in recognition of the services of the Rev. Dr. L. T. Chamberlain to paleontological science.

EDW. J. NOLAN,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB, APRIL 3.

DR. MARCY in chair. Prof. G. W. Hough presented the topic, 'Instruments for Recording the Time of Astronomical Observations.' He described various steps in the use of electric clock signals and the methods of mechanical record of such signals. After explaining a number of contrivances for securing uniform circular motion he described his printing chronograph, which prints with type the minutes, seconds, and hundredths of seconds of the time of the observation. The instrument has been in use since 1871, is easily kept in order, and has a great advantage over the recording chronograph in saving labor in meridian observations.

In the discussion Prof. Crew described devices used in securing uniform circular motion for chronographs at Johns Hopkins and at Lick Observatory.

A. R. CROOK,
Secretary.

EVANSTON, ILL.

NEW BOOKS.

Electric Lighting. Volume I. *The Generating Plant*: FRANCIS B. CROCKER. New York, D. Van Nostrand Co.; London, E. and F. N. Spon. 1896. Pp. viii+444.

Mathematical Papers read at the International Mathematical Congress. Edited by E. HASTINGS MOORE, OSKAR BOLZA, HEINRICH MASCHKE, HENRY S. WHITE. New York, Macmillan & Co., for the American Mathematical Society. 1896. Pp. xvi+411. $4.00.

Wages and Capital. F. W. TAUSSIG. New York, D. Appleton & Co. 1896. Pp. xviii +325.

Ruhmkorff Induction-Coils. H. S. MORRIE. New York, Spon and Chamberlain. 1896. Pp. xviii+183.